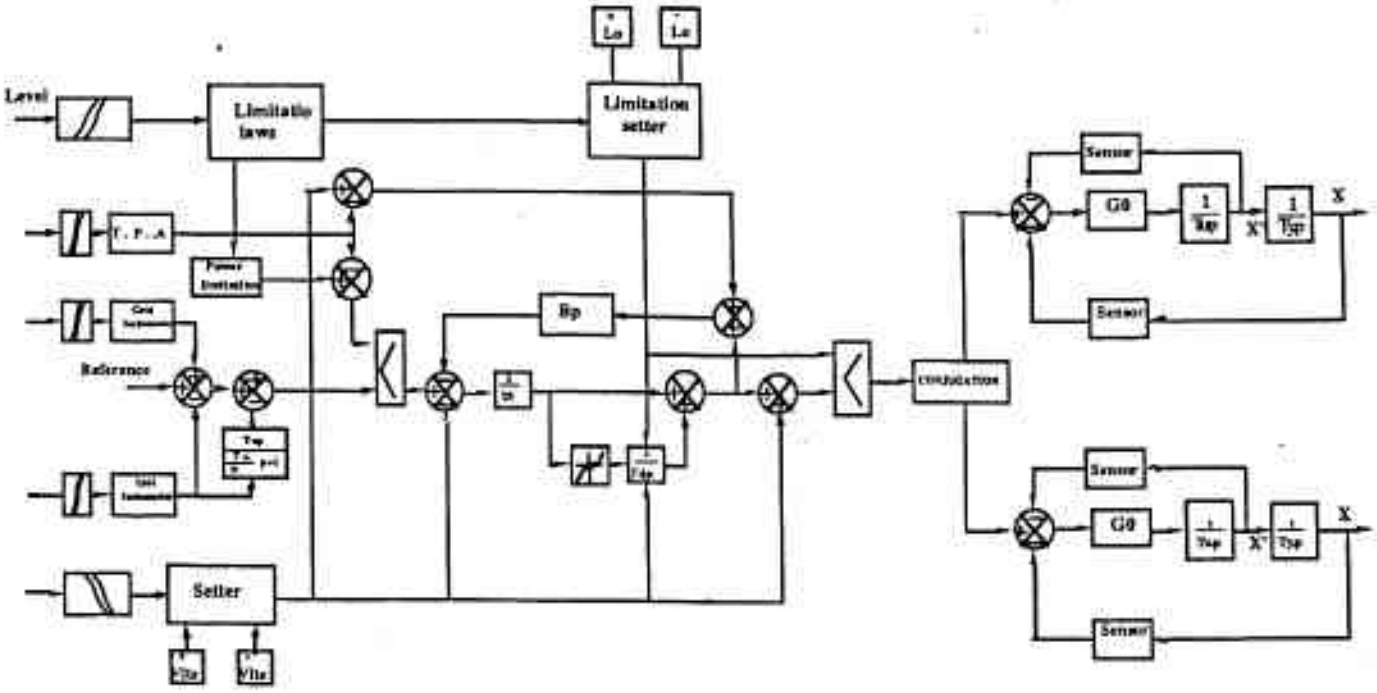
DIGIPID 02

COURSE

THEORY - TECHNOLOGY



Author: D.Aprahamian

Friday, November 13th 1992

Ing. PABLO JUAN THOMASSET TRAKALO
JEFE MANTENIMIENTO
SUB GCIA. CENTRAL HID.
"Dr. GABRIEL TERRA"

Theoretical training prop for the DIGIPID 02

This document does not aim to replace the product documentation, but to provide additional theoretical information to guide the user.
The following documentation is supplied during the course :

DIGIPID 02 Course

General documentation	DIGIPID 02
Functional diagrams	general
Functional diagrams	per task
Diagram connexion	general
Diagram connexion	per task

Hardware documentation	Manuals		Manuals
Governing cabinet	1932	Supply plate	1933
Transformer plate	1934	Ana. I/O Isolating Interface	1935
DIGIPID rack	1936	Digital I/O Isol. Interface	1937
Analog positioner	1938	TR 10 hydraulic chain	1939
E.D. hydraulic chain	1940	Maintenance leaflet	1944
Power 382 Maintenance	1942	Operation/Maintenance	1633
NESTOR 402 Maintenance	1991		

It is subdivided into three chapters :

- The first is a theoretical review of speed governing principles, also applied to the following governors : RAPID 77, RSC 76, MICRO/MINIPID, DIGIPID 1000.
- The second is a technological description more specific to the DIGIPID 02
- The third deals with DIGIPID 02 operating and maintenance procedures

Theoretical speed governing aspects

This chapter describes the following in turn from a theoretical standpoint :

- the general speed governing principles
- the speed governor
- the positioner

The general speed governing principles

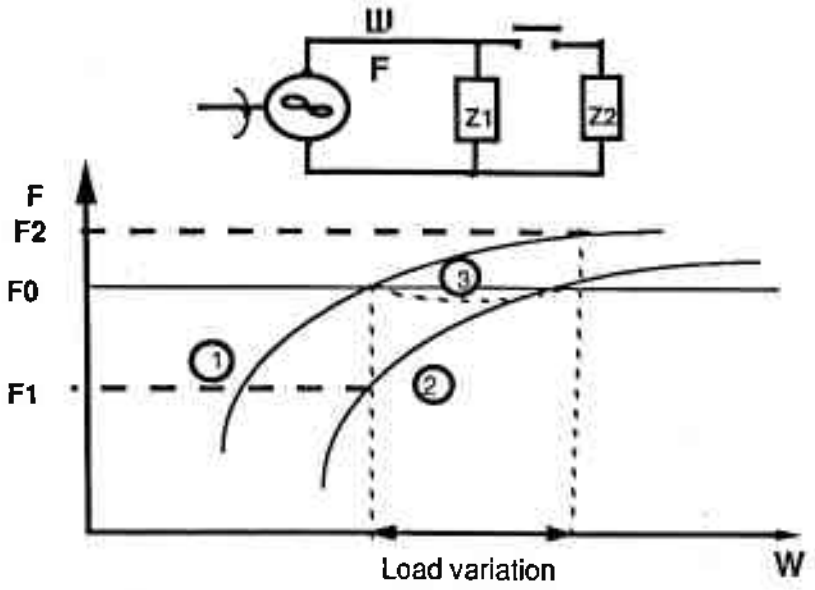
A water-turbine speed governor is required to operate in two clearly separate configurations :

- operation in isolated grid
- operation in interconnected grid

In the first case, the governor alone maintains the grid frequency.

In the second case, it recopies the "load" set-point (opening or power) supplied by the remote adjustment.
The originality of the NEYRPIC governors lies in their ability to ensure in the second case a "primary adjustment means of a law connecting the power supplied to the grid to the value of its frequency.

Isolated Grid

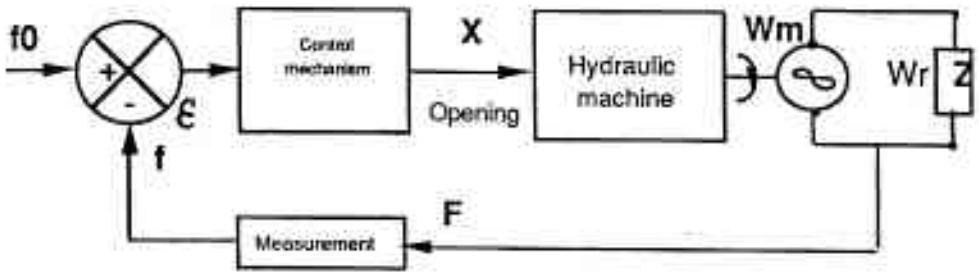


Operating point : intersection of the grid characteristic with that of the governor.

Governor characteristic (in steady state operation) :

W = 0	F > Fo
0 < W < Wm	F = Fo
W = Wm	F < Fo

Auto-adjustment of grid : if there is no speed equalizer, the grid replies to a load variation by adjusting frequency



Governor principle :

f = a1. F

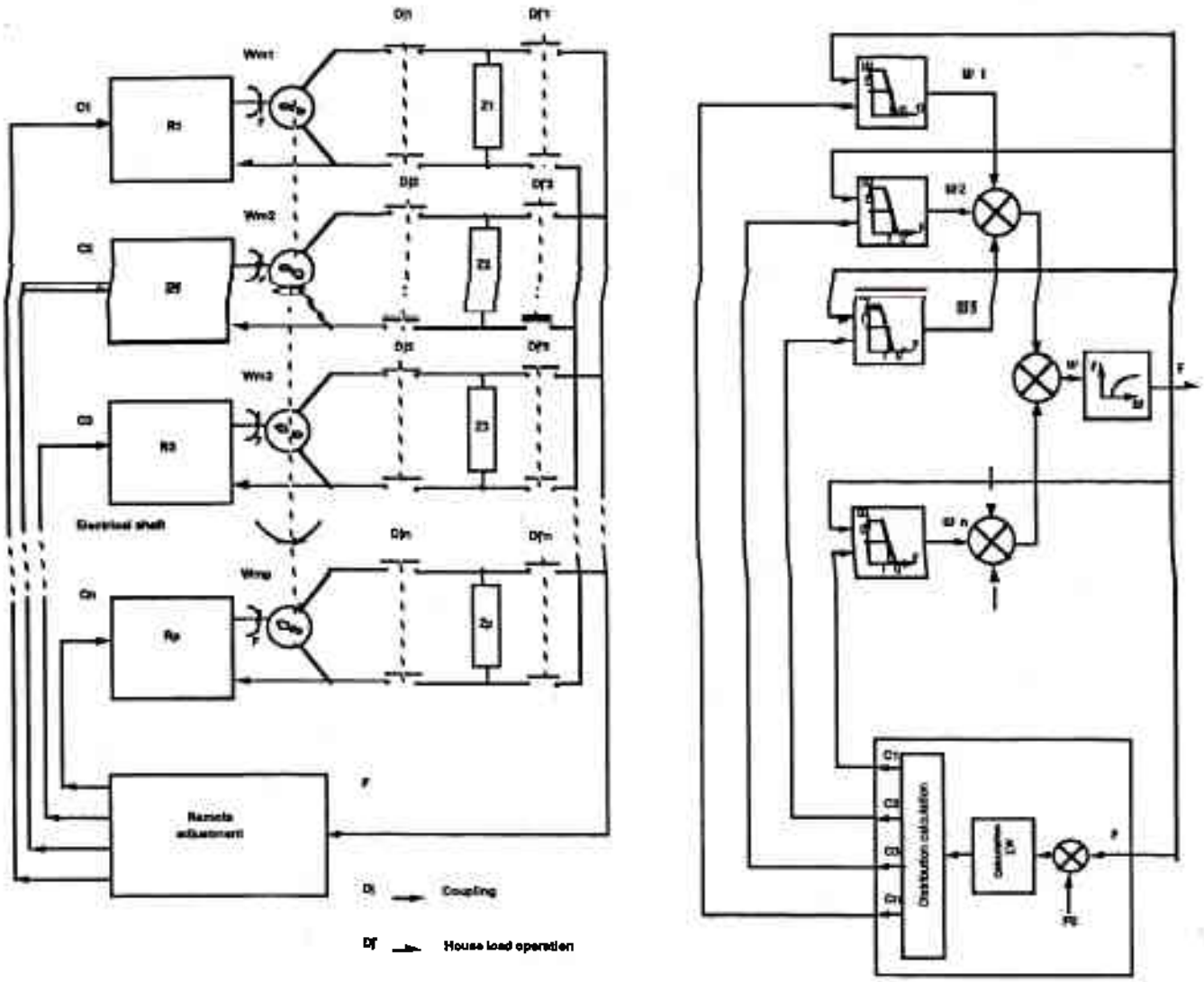
fo = a1. Fo

e = fo - f

a1: tachometer conversion coefficient

The sign ε determines the evolution direction of unit opening X.

Interconnected Grid



Notion of electrical shaft : all the grid units rotate at the synchronism speed : $\Omega = 2.\pi. N. F$

Grid :

$$Wm = \sum_{i=1}^{n} W i$$

Wm: power supplied to grid

$Wr = Wo + K1.F + K2.F2 + K3. F3$

Wr : power consumed by grid

Secondary adjustment : remote adjustment ensures
- calculation of Wr
- distribution of the total power to be supplied, between the various grid units : set-points C_1 to C_n

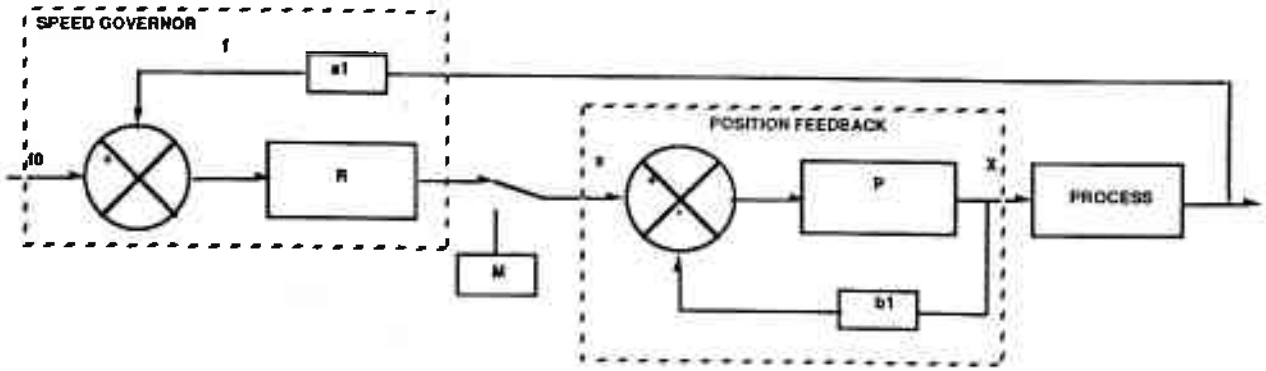
Primary adjustment : Due to its static charge, each governor helps maintain frequency between two secondary Adjustment corrections.

Speed governor structure

Unlike mechanical governors and the RAPID 68,
modern electronic speed governors are made up of two clearly separate parts :

- the speed/load governor which includes the permanent static charge

- the position feedback, whose sole function is to recopy the opening set-point sent by the speed governor or a stanc mechanism :



In the case of DIGIPID 02, these two functions are materially separated :
The position feedback is formed :
- by an analog board
- or by a numerical DIP 1000 positioner.

This separation provides many facilities, in particular :
- a "genuine" standby control mechanism
- easy adapation to various types of machines

This paragraph describes in turn :

The speed governing principle :

- the Proportional, Integral, Derivative speed governor ensures, through these three actions, speed governing prec dynamics.

- the study of the functional diagram detailed in the technological part shows that implementation of this princ requires many auxiliary functions, in particular non-linearities and limitations.

Standardized I.E.C. vocabulary (International Electrical Commission)
Its principle consists in considering the operator (gain, shunting device, integrator) as a "black box" and in charac by its response to a standardized signal (step, ramp,...).

The position feedback principle :

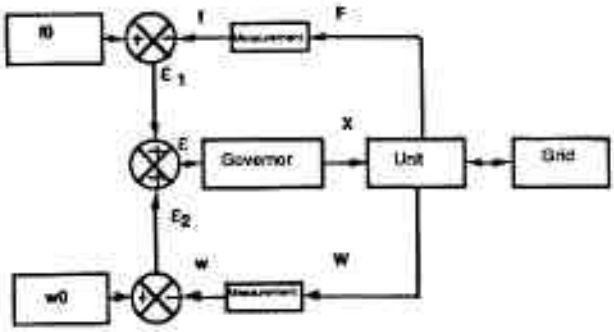
The ideal positioner would be such that : $X = \frac{1}{b_1} . x$

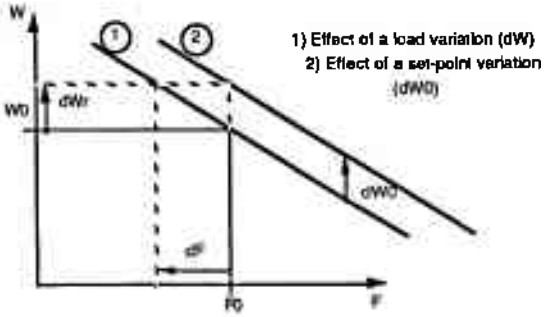
Its adjustments must thus be optimized so as to minimize its response time.

Permanent static charge

1) Governor characteristic (in steady state operation) :

W = 0	F > F1
W = C	F = F0
W = Wm	F < F2
0 < W < Wm	F1> F> F2





2) Creation :

$\varepsilon = 0$ (1)

The governor continuously calculates the opening required to make e zero.

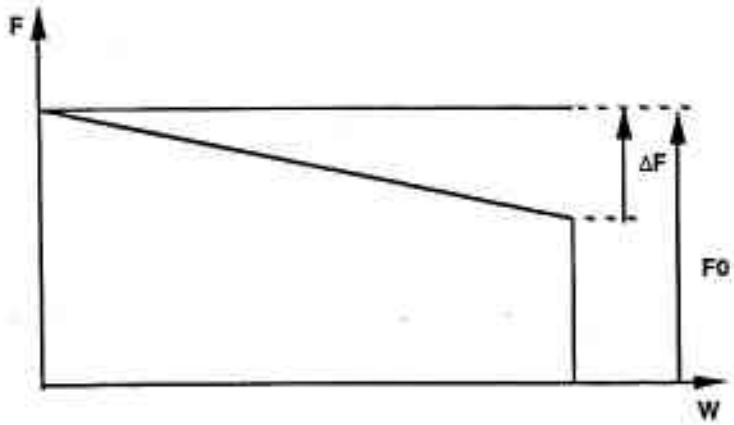
$\varepsilon = \varepsilon_1 + \varepsilon_2$ (2)

$$W0 - W = -\frac{a_1}{a_2} \cdot (F0 - F)$$

$\varepsilon 1 = a_1.(F0-F)$ (3)

$\varepsilon 2 = a_2.(W0-W)$ (4)

3) Definition :



$$bp = \frac{\Delta F}{F0}$$

$$bp = \frac{dF}{dW} \cdot \frac{W0}{F0}$$

if bp constant for all operating points :

$$bp = \frac{\Delta F}{F0}$$

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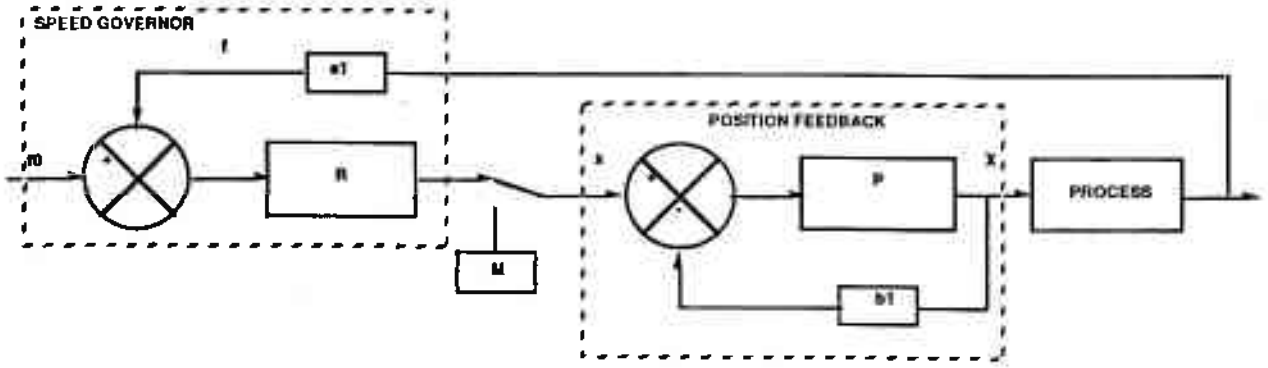

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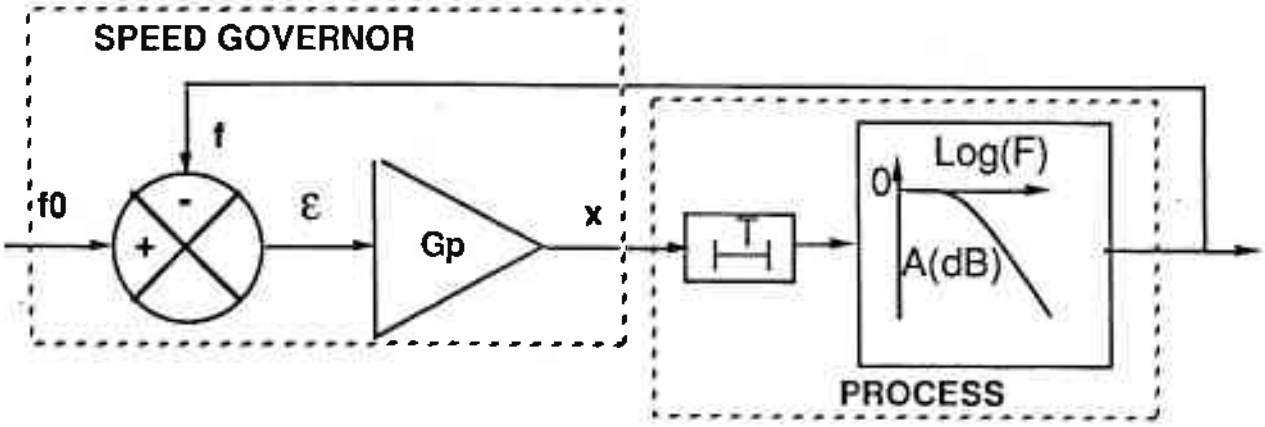
P.I.D. Governor Actions



Simplified process model :

The process is represented by :
- A pure T constant delay (signal propagation time through positioner, hydraulic turbine stage, wheel, AC genera
- An attenuation A depending on pulsation of input signal x $A = \frac{1}{\sqrt{1+k^2.\omega^2}}$

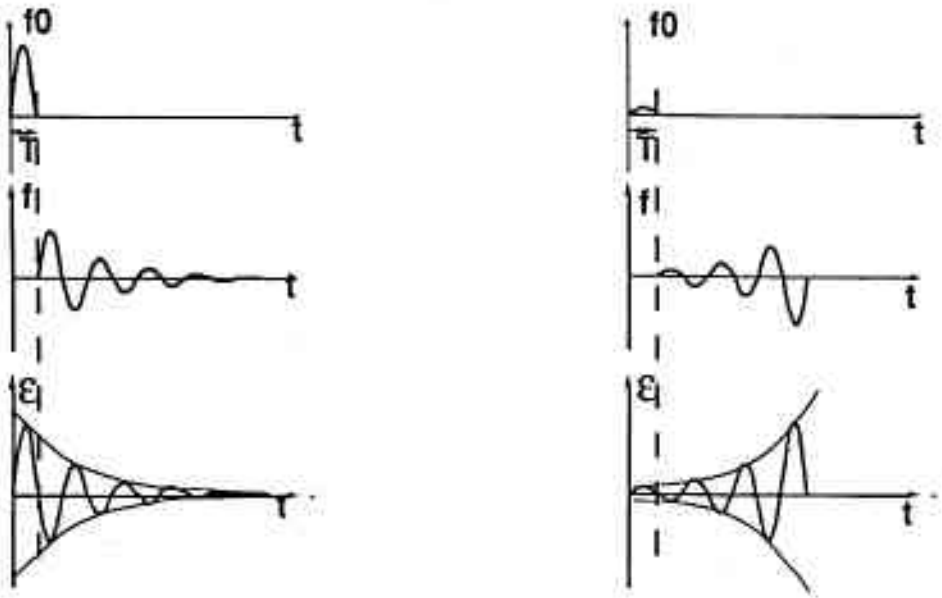
Pulsation : $\omega_0 = \frac{\pi}{T}$ is known as the pulsation specific to the process :

- the phase shift is then equal to P and the attenuation to A_0

Proportional governor :
if the speed governor consists of a proportional gain Gp_1, then:

$$\bar{f}(\omega_0) = A_0.Gp_1.\bar{\varepsilon} \text{ with } A_0 = \frac{1}{\sqrt{1+k^2.\omega_0^2}}$$

If $A_0.G_{p1} \leq$ the response is "stable" If $A_0.G_{p1} >$ the response is "unstable"



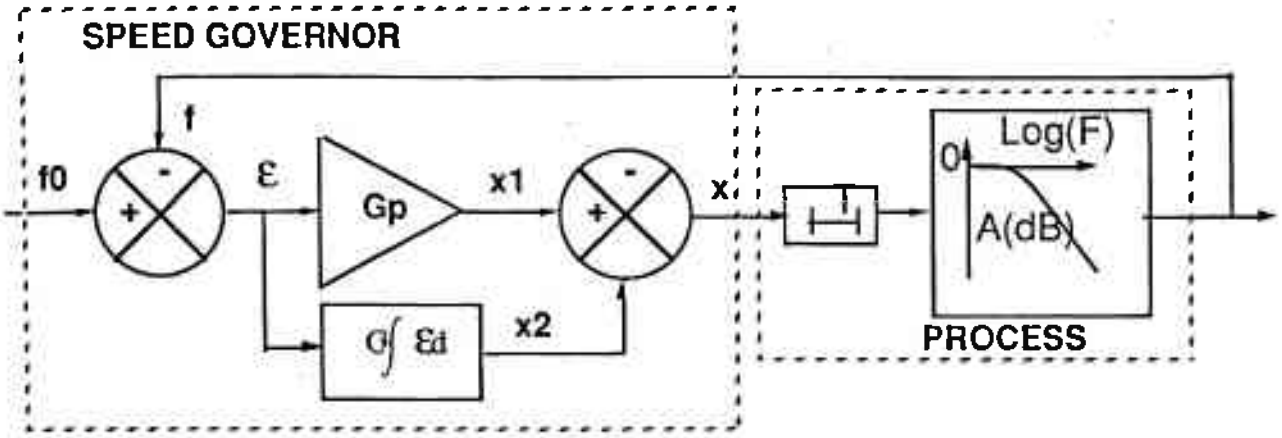
The response tends towards instability when Gp increases.

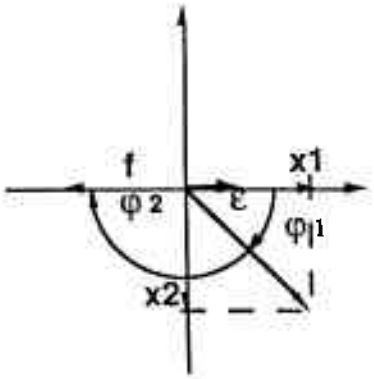
Precision of the proportional governor

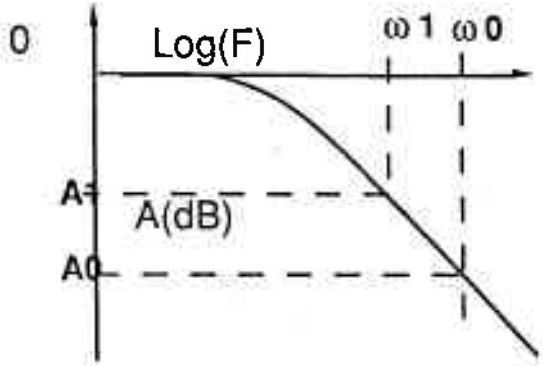
This precision can be expressed by the quantity : $\frac{fo}{\varepsilon m} = \frac{Gp.fo}{xm}$

Precision of the proportional governor is limited by the value of the gain imposed by the stability constraints.

Proportional - Integral Governor :







The precision adjustment problem can be solved by adding an integral term : output x2 of the integrator evolves pr is not zero.

- The governor output is then equal to : $\vec{x} = \vec{x}_1 + \vec{x}_2$

- its gain is : $Gr_1 = \sqrt{Gp^2 + \frac{Gi^2}{\omega_1^2}}$

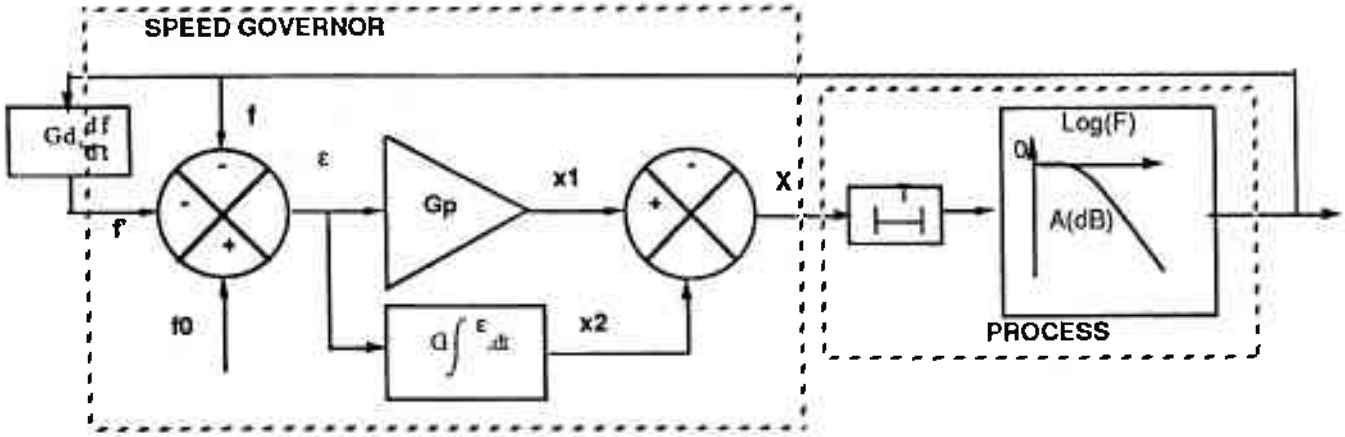
- its phase shift : $\varphi_1 = \text{Arc tg} \frac{Gi}{Gp.\omega_1}$

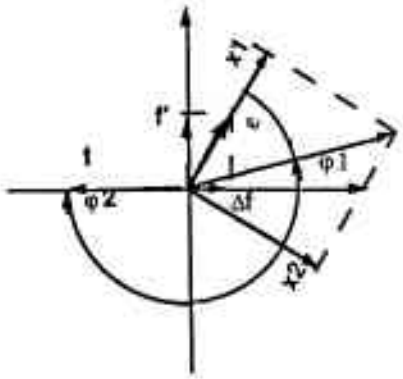
The critical pulsation becomes : $\omega_1 = \frac{\pi - \varphi}{T}$ $\qquad A_1 = \frac{1}{\sqrt{1 + k^2.\omega_1^2}} > A_0$

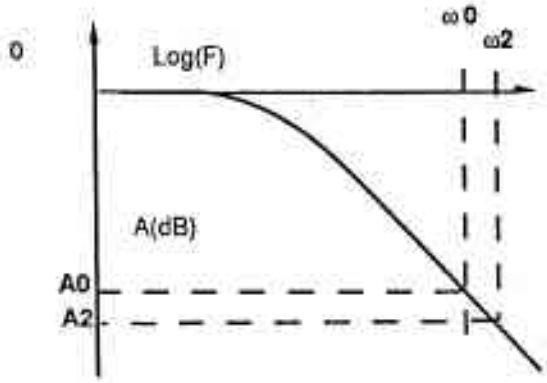
- The maximum admissible value of Gr_1 is less than G_1 of the proportional governor :

The precision problem is solved at the cost of a reduction in dynamic performances.

P.I.D. Governor :







The governor dyanamics can be improved by additing a derivative term :

- The governor output is then equal to : $\vec{x} = \vec{x_1} + \vec{x_2}$

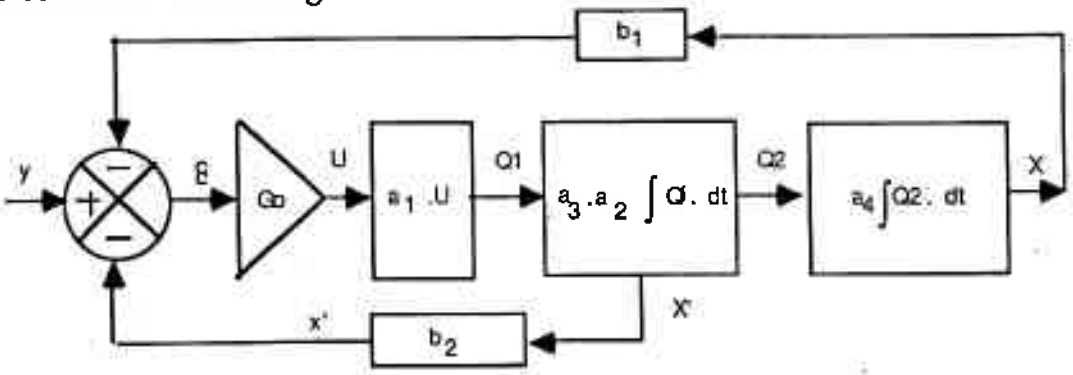
- its gain is : $Gr_2 = \sqrt{\left(1+(Gd.\omega)^2\right).\left(Gp^2+\frac{Gi^2}{\omega_2^2}\right)}$

- its phase shift : $\varphi_i - \varphi_d = \text{Arc tg}\,\frac{Gi}{Gp.\,\omega_2} - \text{Arc tg}\,Gd.\omega_2$

The critical pulsation becomes : $\omega_2 = \frac{\pi - \varphi_i + \varphi_d}{T}$ $\qquad A_1 \simeq \frac{1}{\sqrt{1+k^2.\omega_2^2}} \leq A_0$

- The maximum admissible value of Gr_2 can be made equal to or greater than G_1 of the proportional governor by adjusting Gd.

Positioner Modelling



Actuator	Distributor	Servomotor
Q1= a1.U (1)	X'= a2 ∫ Q1.dt (2) Q2= a3.X' (3). X'=a1.a2.∫U.dt (5)	X= a4∫ Q2.dt (4) X= a3.a4.∫X'.dt (6)

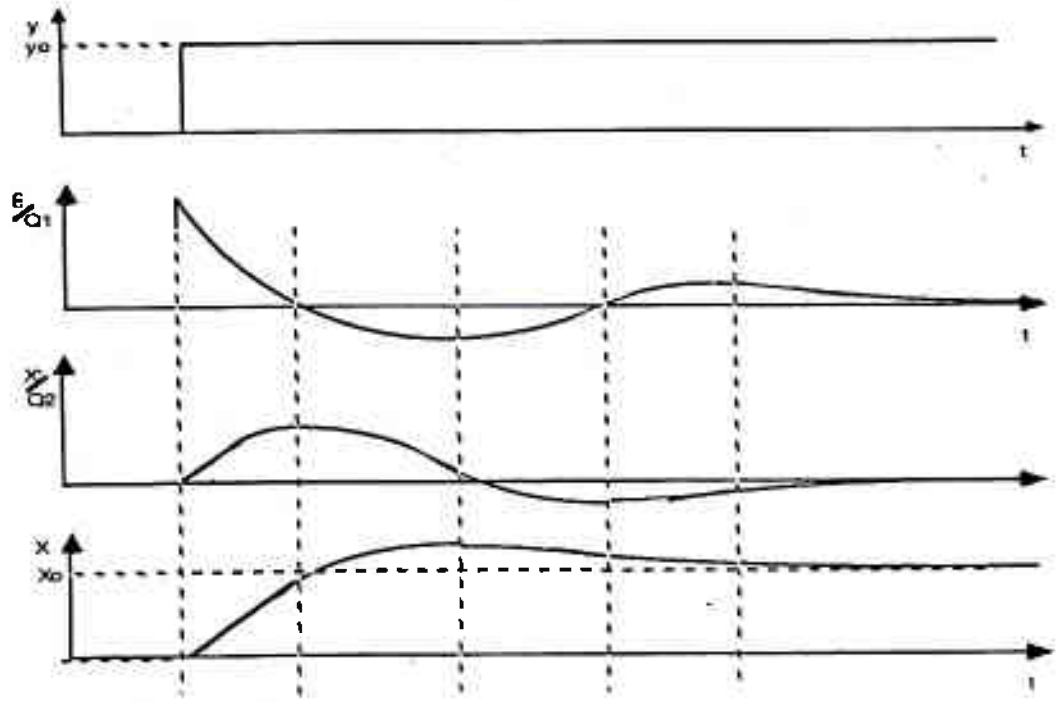
Feedback : objective E=y- x=0 ($x=b_1X$)

U = GoE (the servomotor acting as an integrator)

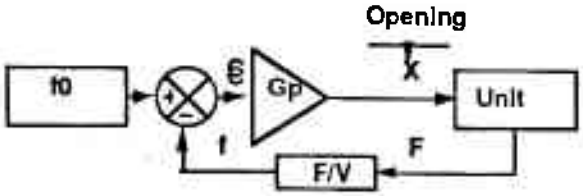
The phase shift obtained is $\phi = \pi$ (hydraulic oscillator)
E=y - (x= x') x'=b2 X'

$$X' = \frac{1}{a3.a4} \cdot \frac{dX}{dt}$$

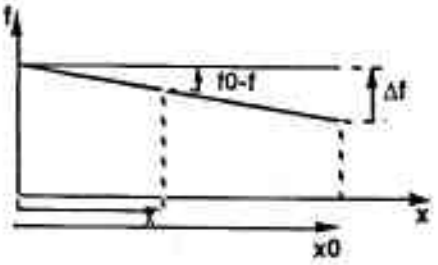
In the case of ED type actuators, this term will be calculated using an accelerometer circuit.

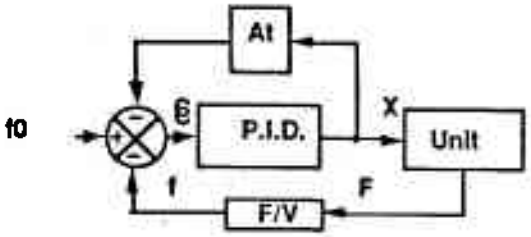


Governor parameters : as in I.E.C.



Calculation of bt
x = Gp.ε
ε = f0-f





Calculation of bt
(f0-f) At.x = ε
ε = 0

$$\frac{f0-f}{x} = \frac{\Delta f}{x0}$$

Transient static charge : bt

$$x = Gp.(f0-f) \quad (1)$$

$$\frac{x}{(f_0-f)} = \frac{x_0}{\Delta f} = Gp \quad (2)$$

$$\frac{x}{x_0} = \frac{Gp.}{f_0}\frac{(f0-f)}{x_0} \quad f0 \quad (1')$$

$$\frac{x}{x_0} = \frac{x_0.}{\Delta f}\frac{(f0-f)}{f_0} \quad \frac{f_0}{x0}$$

$$\frac{x}{x_0} = \frac{1}{bt}\frac{x_0.}{f_0}\frac{(f0-f)}{x0}$$

If x0 = f0

$$x = \frac{1}{bt}(f0-f)$$

Steady state static charge : bp

$$x = \frac{1}{At}.(f0-f) \quad (1)$$

$$\frac{x}{(f_0-f)} = \frac{x_0}{\Delta f} = \frac{1}{AT} \quad (2)$$

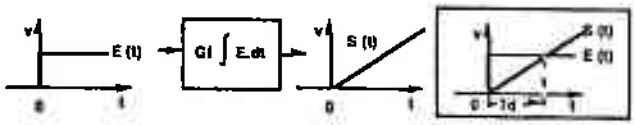
$$\frac{x}{x_0} = \frac{1.}{At}\frac{(f0-f)}{f_0}\frac{f_0}{x_0} \quad (1')$$

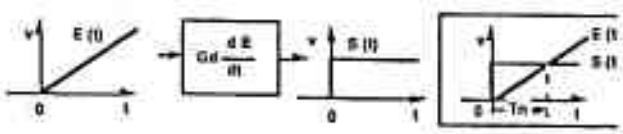
$$\frac{x}{x_0} = \frac{x_0.}{\Delta f}\frac{(f0-f)}{f_0}\frac{f_0}{x0}$$

$$\frac{x}{x_0} = \frac{1}{bp}\frac{x_0.}{f_0}\frac{(f0-f)}{x0}$$

if x0 = f0

$$x = \frac{1}{bp}(f0-f)$$





Integral time constant

$S(t) = Gi.\int E.dt$ | E = constant $t \geq 0$

$S(t) = Gi.E.t$ | $E = 0$ $t > 0$

$S(Td) = E(Td)$ definition

$E(Td) = Gi.E.Td$

$$Td = \frac{1}{Gi}$$

Derivative time constant

$$S(t) = Gd.\frac{dE}{dt}$$ $E = co.t$ $t \geq 0$

$E = 0$ $t > 0$

$S(t) = Gd.co$

$S(Tn) = E(Tn)$ definition

$E(Tn) = co.Tn$

$$Tn = Gd$$

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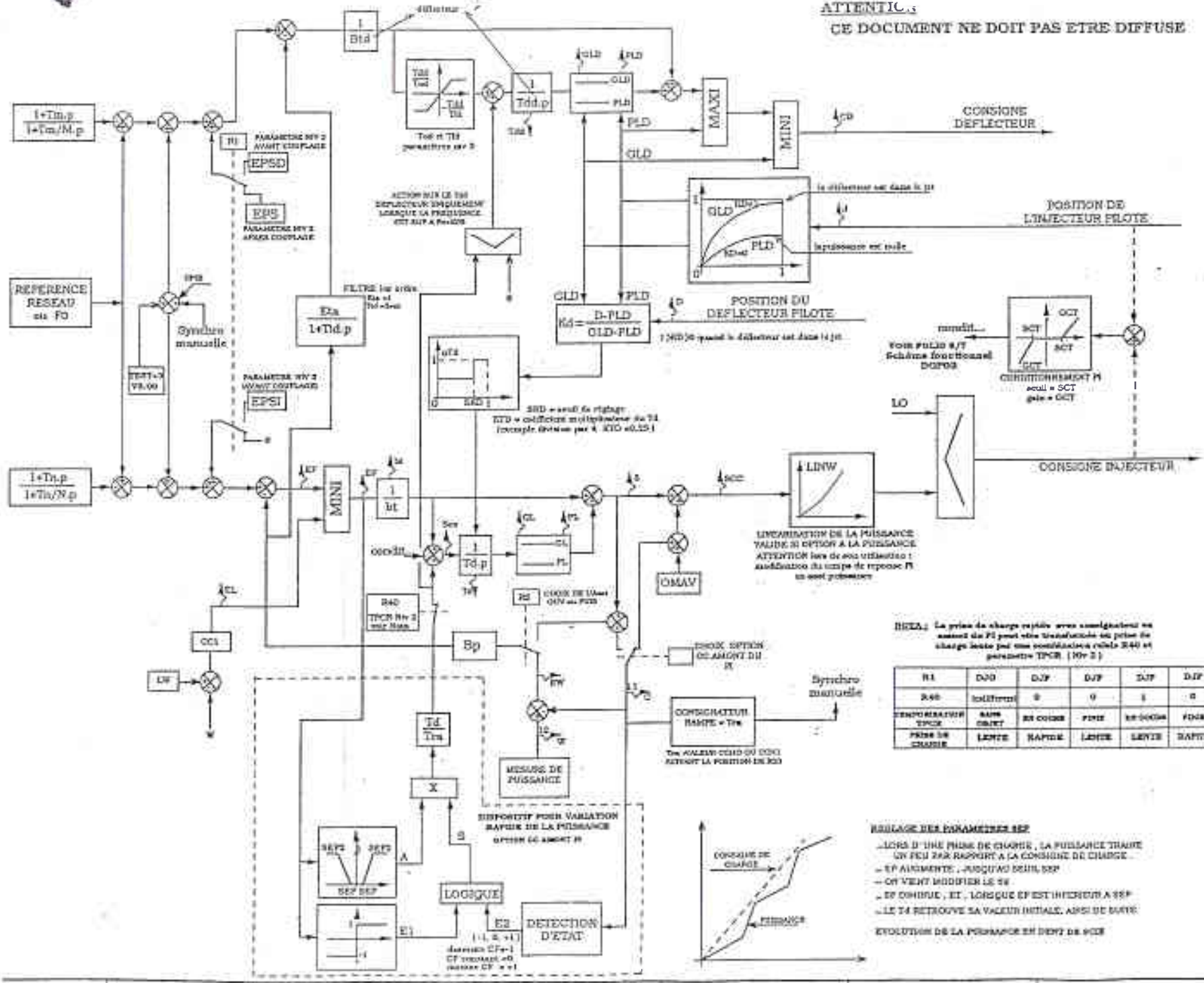

R1	D20	D2F	D2F	D2F	D2F
R40	Indifférent	0	0	1	0
CONFIGURATION TPCR	SANS OBJET	EN COURS	FINIE	EN COURS	FINIE
PRISE DE CHARGE	LENTE	RAPIDE	LENTE	LENTE	RAPIDE

CLIENT					
AFFAIRE					
CODE					
PLAN SERIE	ECH : -	GEC ALSTHOM			
SERIE N°	DESSINE PAR : STS				
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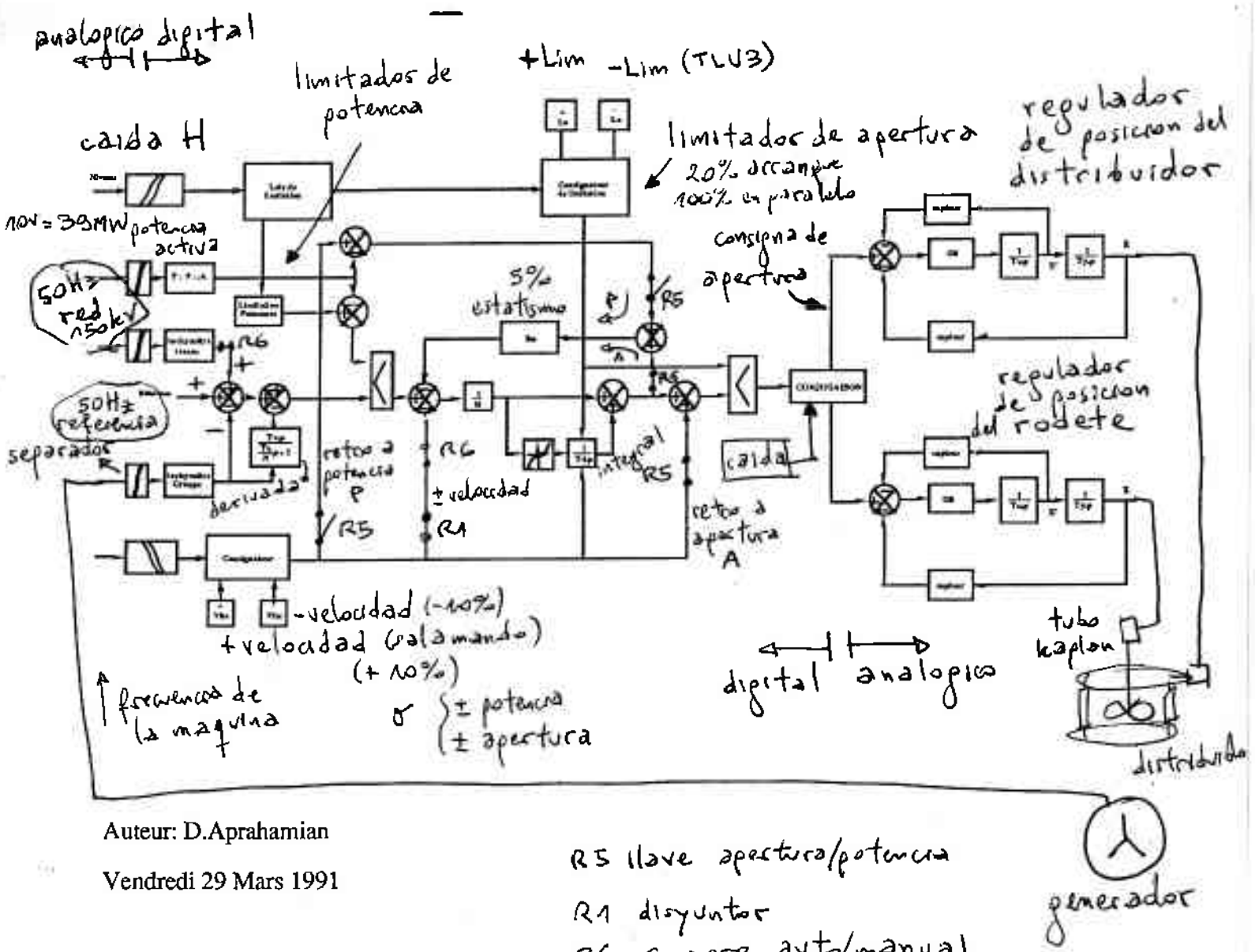
DIGIPID 02
SCHEMA FONCTIONNEL
PELTON 3 DETAILLE

NUMERO A



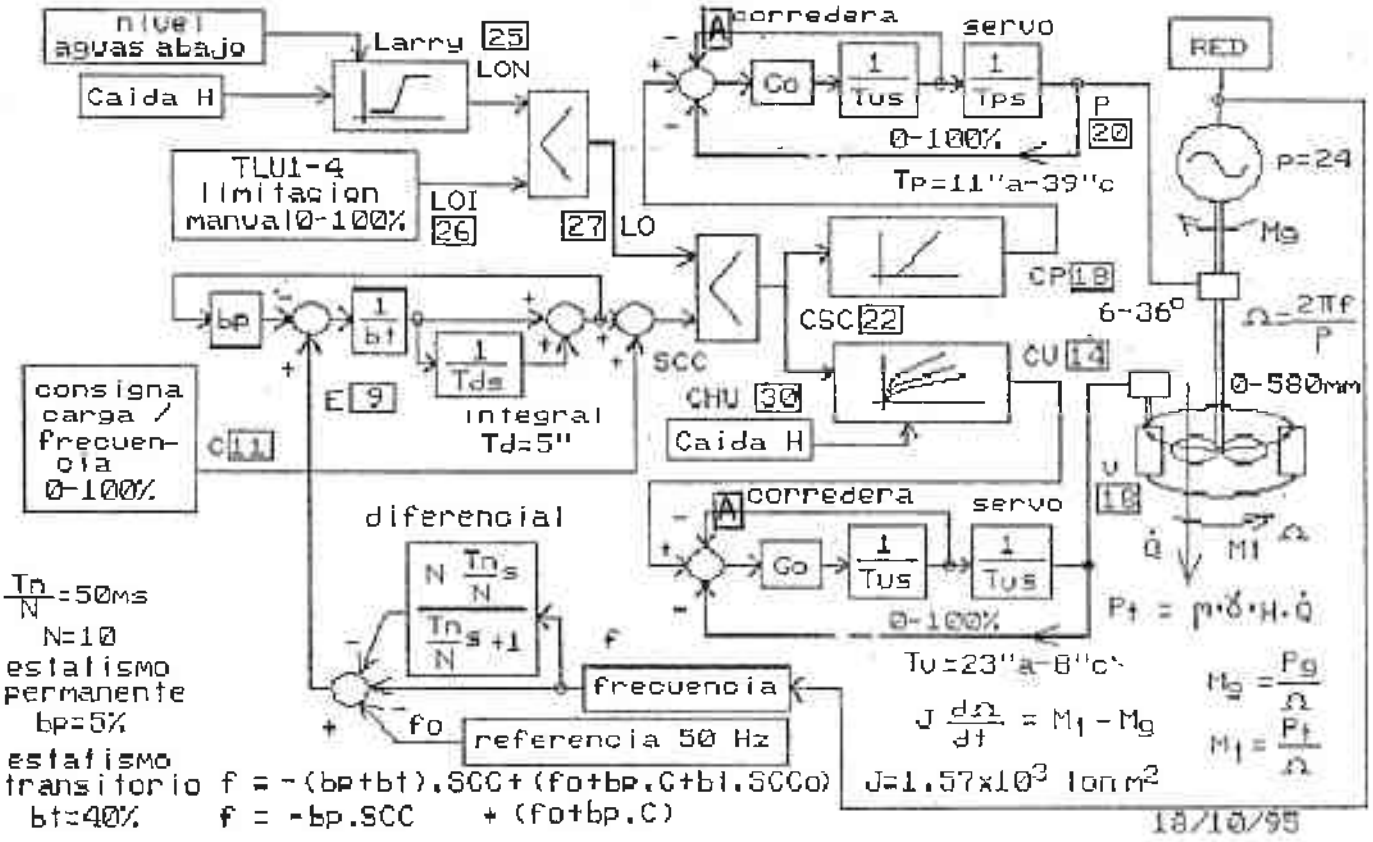
Auteur: D.Aprahamian

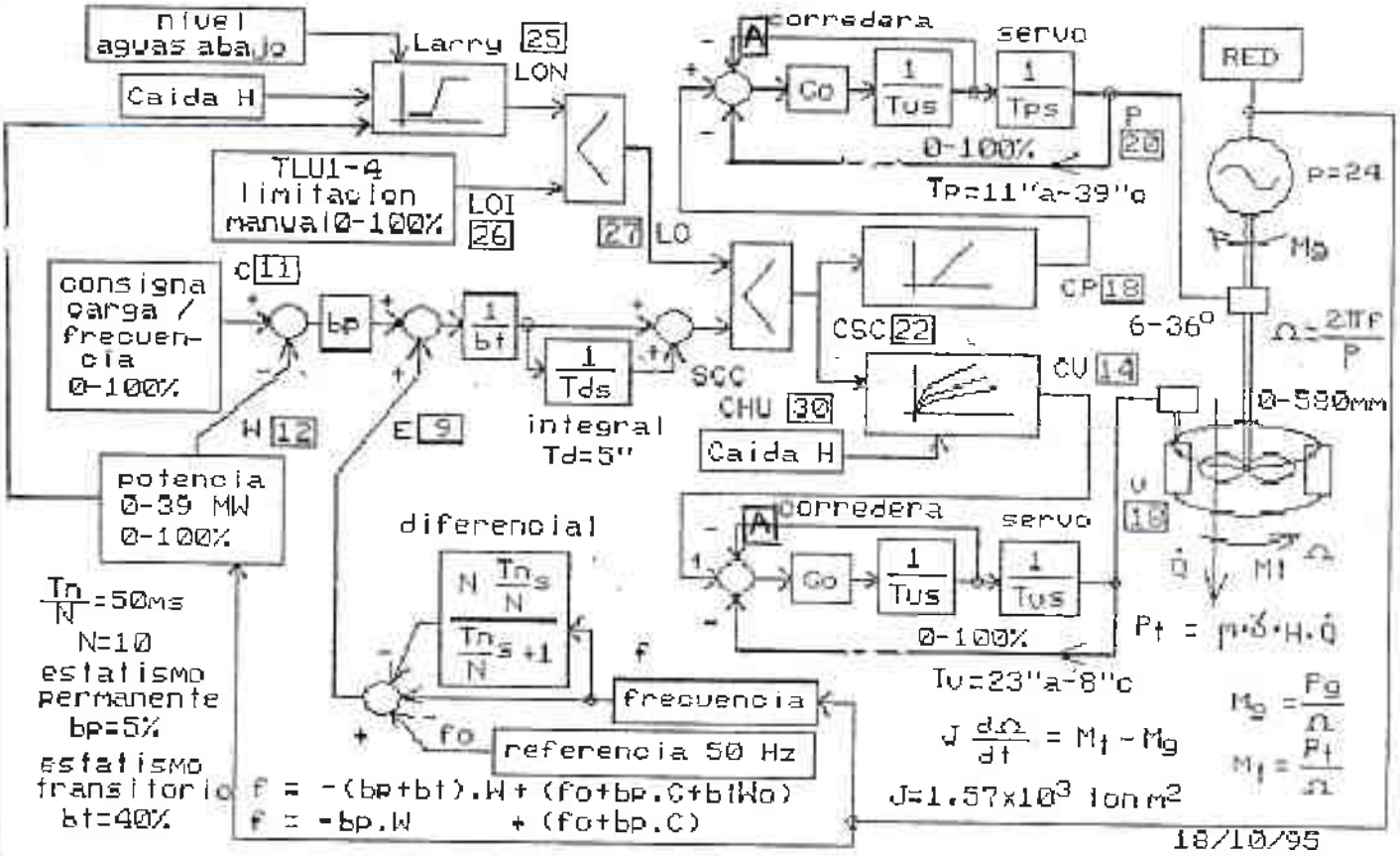
Vendredi 29 Mars 1991

R5 llave apertura/potencia

R1 disyuntor

R6 syncro auto/manual


nivel aguas abajo
Caida H
Larry 25
LON
TLU1-4 limitacion manual 0-100%
LOI 26
27 LO
A corredera
servo
Co
1/Tus
1/Tps
P 20
0-100%
Tp=11"a-39"c
RED
p=24
Mg
CP 18
CSC 22
CU 14
6-36°
Ω=2πf/P
0-580mm
SCC
CHU 30
Caida H
consigna carga / frecuencia 0-100%
C 11
E 9
bp
1/bt
1/Tds
integral Td=5"
diferencial
N Tns/N / Tns/N +1
f
fo
referencia 50 Hz
frecuencia
Tn/N=50ms
N=10
estatismo permanente bp=5%
estatismo transitorio bt=40%
f = -(bp+bt).SCC+(fo+bp.C+bt.SCCo)
f = -bp.SCC + (fo+bp.C)
U 10
Q̇
M1
Go
Tv=23"a-8"c
Pt = p·g·H·Q̇
Mg = Pg/Ω
M1 = Pt/Ω
J dΩ/dt = M1 - Mg
J=1.57x10³ ton m²
18/10/95


nivel aguas abajo
Caida H
Larry 25
LON
TLU1-4 limitacion manual 0-100%
LOI 26
27 LO
A corredera
servo
Co
1/Tus
1/Tps
P 20
0-100%
Tp=11"a-39"c
RED
p=24
Mg
CP 18
CSC 22
CU 14
6-36°
Ω=2πf/P
0-580mm
SCC
CHU 30
Caida H
consigna carga / frecuencia 0-100%
C 11
H 12
E 9
potencia 0-39 MW 0-100%
bp
1/bt
1/Tds
integral Td=5"
diferencial
N Tns/N / Tns/N +1
f
fo
referencia 50 Hz
frecuencia
Tn/N=50ms
N=10
estatismo permanente bp=5%
estatismo transitorio bt=40%
f = -(bp+bt).W+(fo+bp.C+bt.Wo)
f = -bp.W + (fo+bp.C)
U 10
Q̇
M1
Go
Tv=23"a-8"c
Pt = p·g·H·Q̇
Mg = Fg/Ω
M1 = Pt/Ω
J dΩ/dt = M1 - Mg
J=1.57x10³ ton m²
18/10/95

Esquema de regulacion

$$\begin{cases} P = \dfrac{U_s\,E_f}{X_d}\,\text{sen}\,\theta \\ Q = \dfrac{U_s\,E_f}{X_d}\cos\theta - \dfrac{U_s^2}{X_d} \end{cases} \qquad \begin{cases} P = \dfrac{U_s\,U_r}{X_t}\,\text{sen}\,\phi \\ Q = \dfrac{U_s}{X_t}^2 - \dfrac{U_s\,U_r}{X_t}\cos\phi \end{cases}$$

K1=20.4 K2=5.1 X_d=4.3 Ω X_t=0.58 Ω

T'=1" T=1" Tv=20ms

br=4.5%

L/r=0.5"

$U_s = U_o + br\,\frac{Q}{S_n}\,U_{sn}$

Red

Ur

161 kV / 13.8 kV

36 MVA

11.4%

P, Q, U_s

560Vca

40 MVA

90.5 %

corriente excitacion

tension de mando

If max 120%=864A

consigna tension 2.5-15.2kV 90-110%

Uo

K2

K1

$1+\frac{1}{T's}$

$1+\frac{1}{Ts}$

integral

Uca

Uf

campo

$\frac{1/r}{1+\frac{L}{r}s}$

I_f

E_f

$\frac{Efo}{Ifo} = \frac{13.8kV}{410\ A}$

Ufn=244V If n=720A

Ufmax=659V Ifmax=1150A-10"

br Is sen φ

estatismo de reactiva

corriente estator

$\frac{1}{1+Tus}$

tension estator

nivel aguas abajo

Caida H

Larry 25

LON

TLU1-4 limitacion manual 0-100%

LOI 26

27 LO

corredera

servo

Go

$\frac{1}{Tus}$

$\frac{1}{Tps}$

0-100%

Tp=11"a-39"c

P 20

RED

p=24

Mg

consigna carga / frecuencia 0-100%

C 11

bp

bt

Tds

integral Td=5"

W 12

E 9

SCC

CP 18

CSC 22

CV 14

CHV 30

Caida H

δ-36°

$\Omega = \frac{2\pi f}{P}$

0-580mm

potencia 0-39 MW 0-100%

diferencial

$N\,\frac{Tn_s}{N}$ / $\frac{Tn_s}{N}+1$

$\frac{Tn}{N}$=50ms

N=10

estatismo permanente bp=5%

estatismo transitorio bt=40%

f

fo

frecuencia

referencia 50 Hz

v 19

Q

M1

$P_t = p\cdot\delta\cdot H\cdot Q$

Tv=23"a-8"c

$J\,\frac{d\Omega}{dt} = M_t - M_g$

$J = 1.57\times10^{-3}$ ton m^2

$M_g = \frac{Pg}{\Omega}$

$M_t = \frac{P_t}{\Omega}$

f = -(bp+bt).W + (fo+bp.C+btWo)

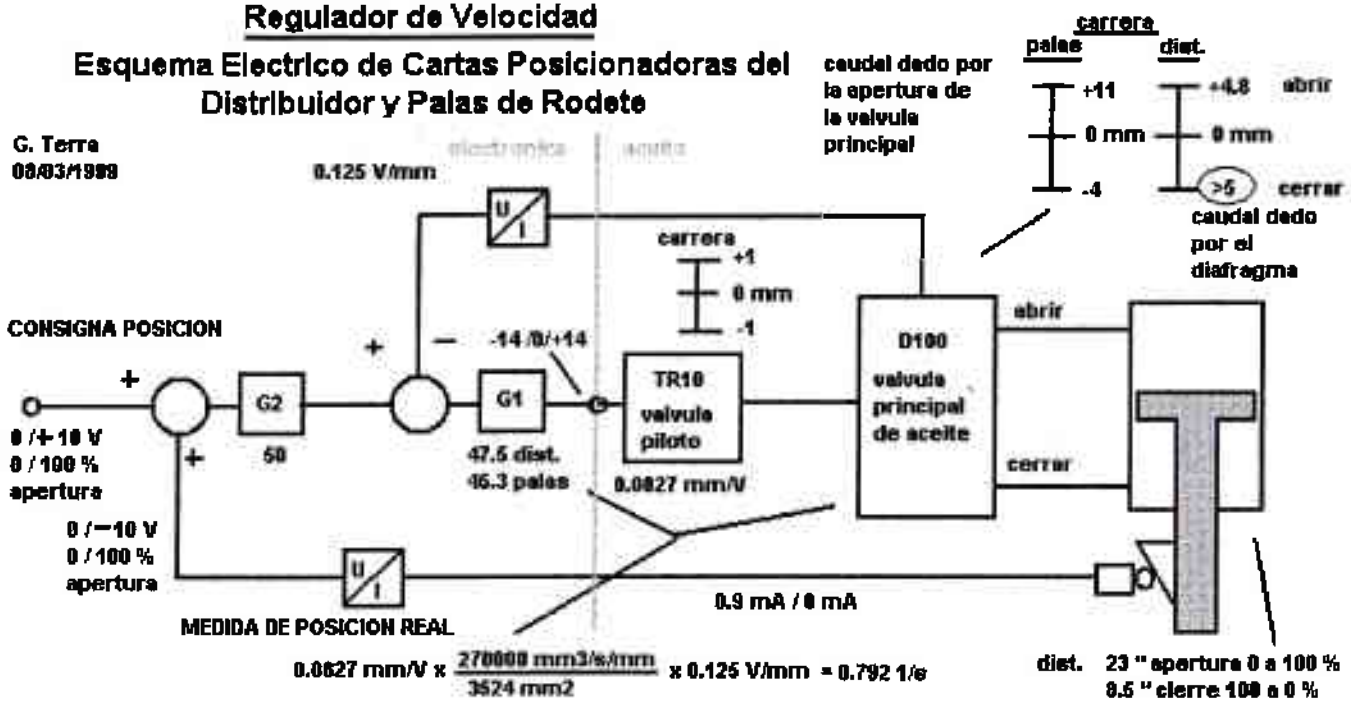
f = -bp.W + (fo+bp.C)

6/10/95

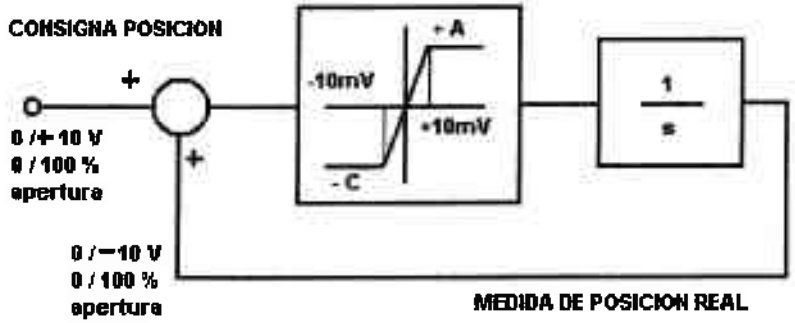
posicionadoras (800x600x16M bmp)

Regulador de Velocidad

Esquema Electrico de Cartas Posicionadoras del Distribuidor y Palas de Rodete

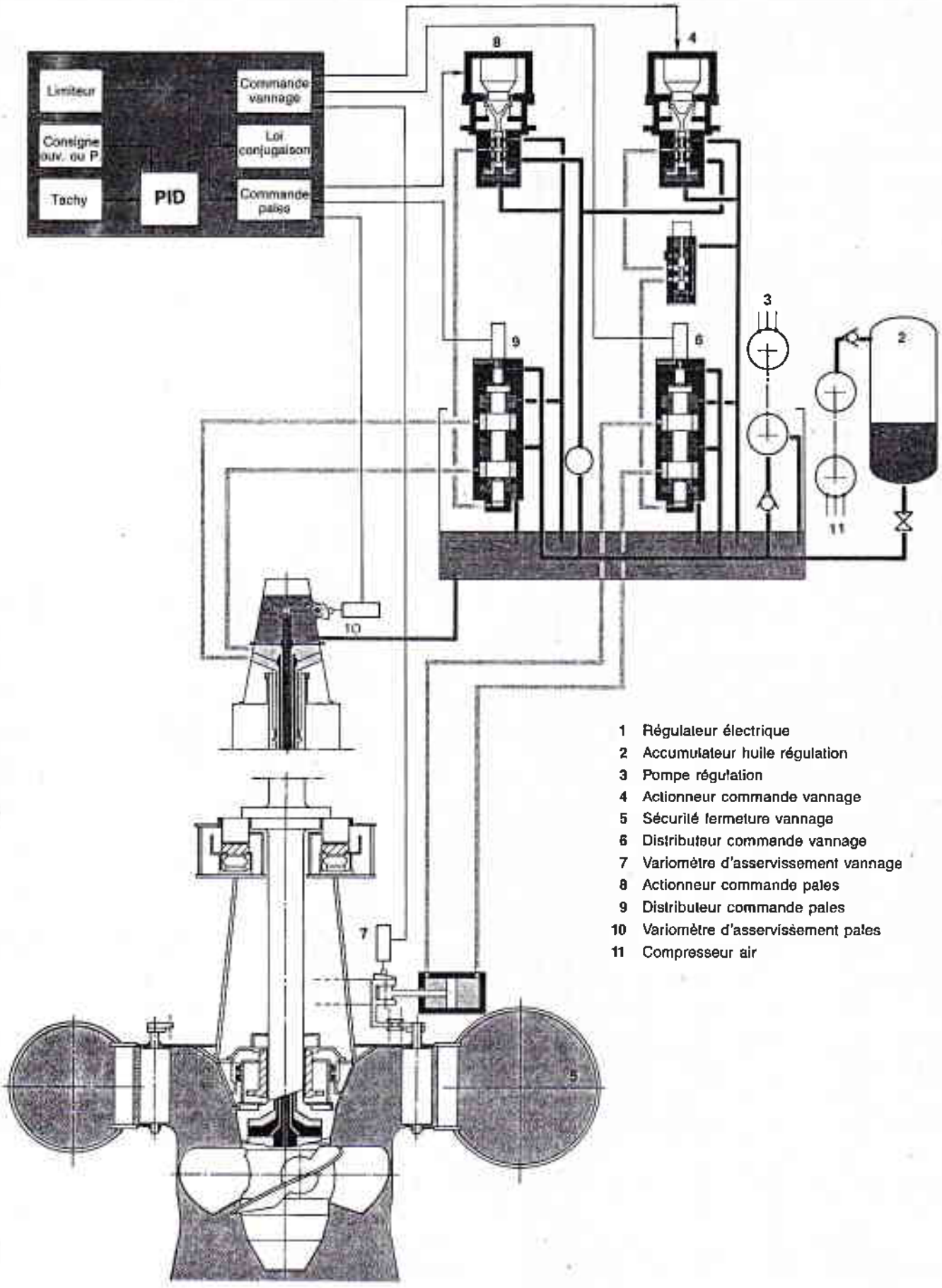


Modelo Simplificado

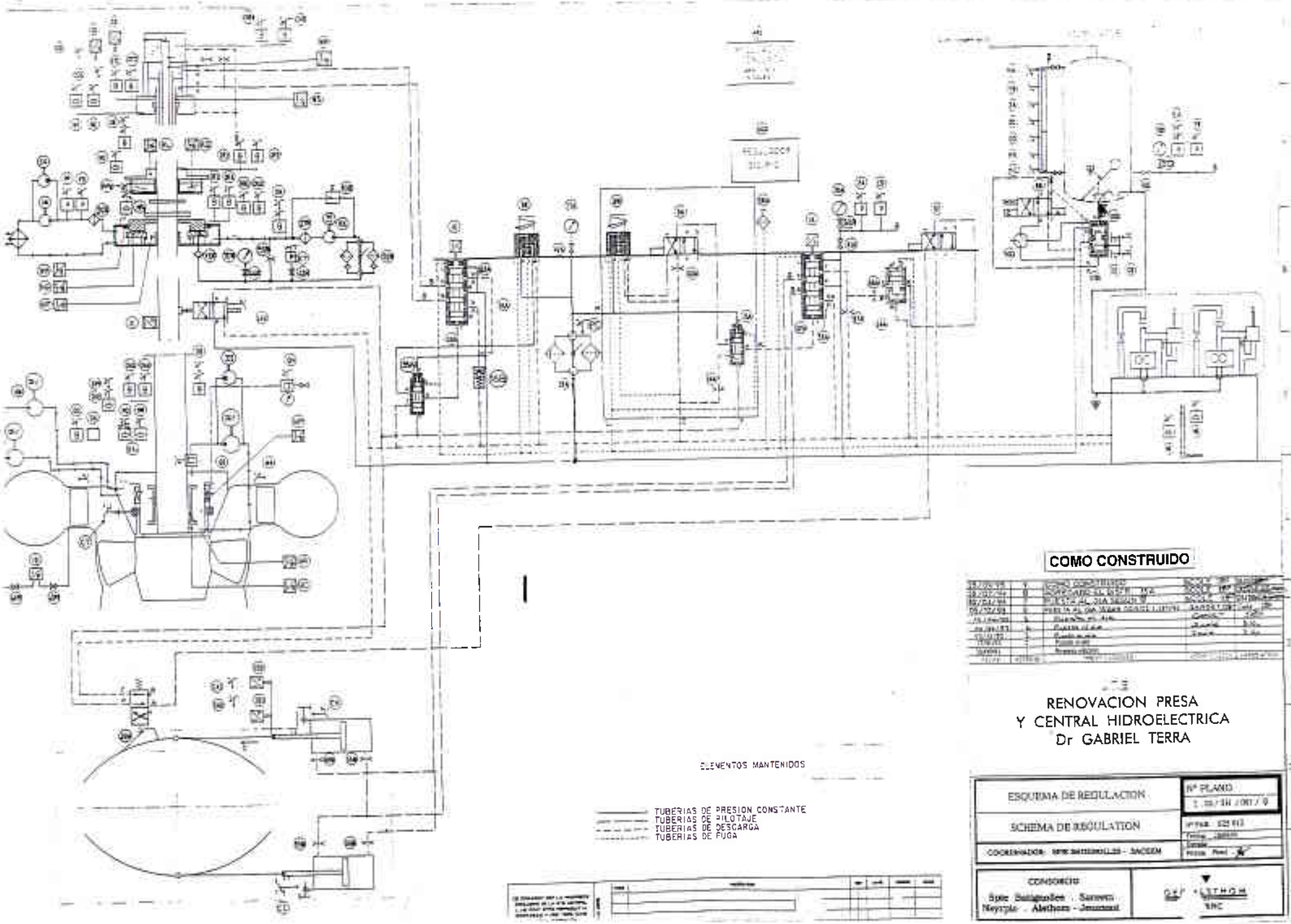


	A	C
dist.	10/23	10/8.5
palas	10/11	10/39

modelo valido para pequeña y grande señal



1 Régulateur électrique
2 Accumulateur huile régulation
3 Pompe régulation
4 Actionneur commande vannage
5 Sécurité fermeture vannage
6 Distributeur commande vannage
7 Variomètre d'asservissement vannage
8 Actionneur commande pales
9 Distributeur commande pales
10 Variomètre d'asservissement pales
11 Compresseur air



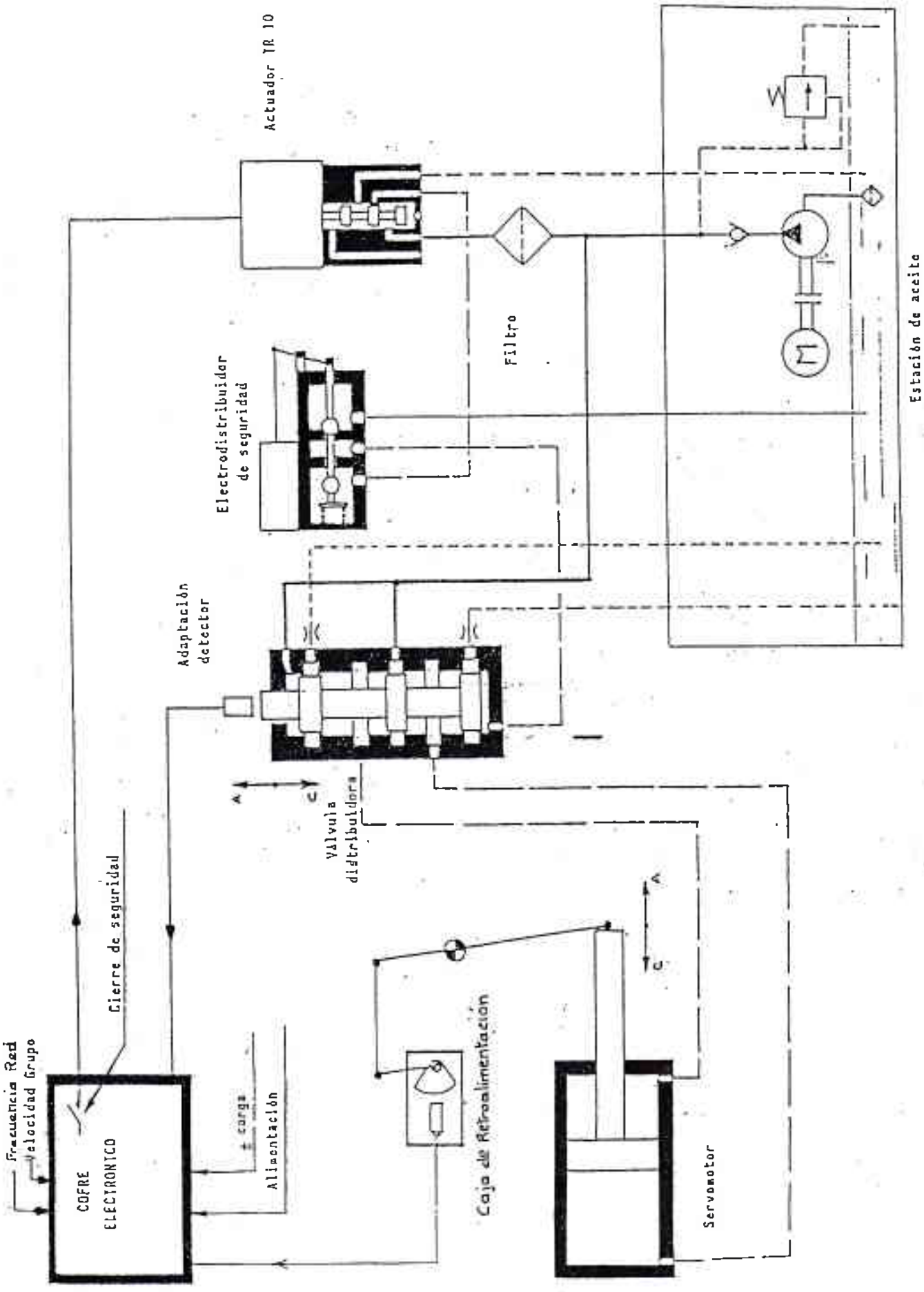
COMO CONSTRUIDO

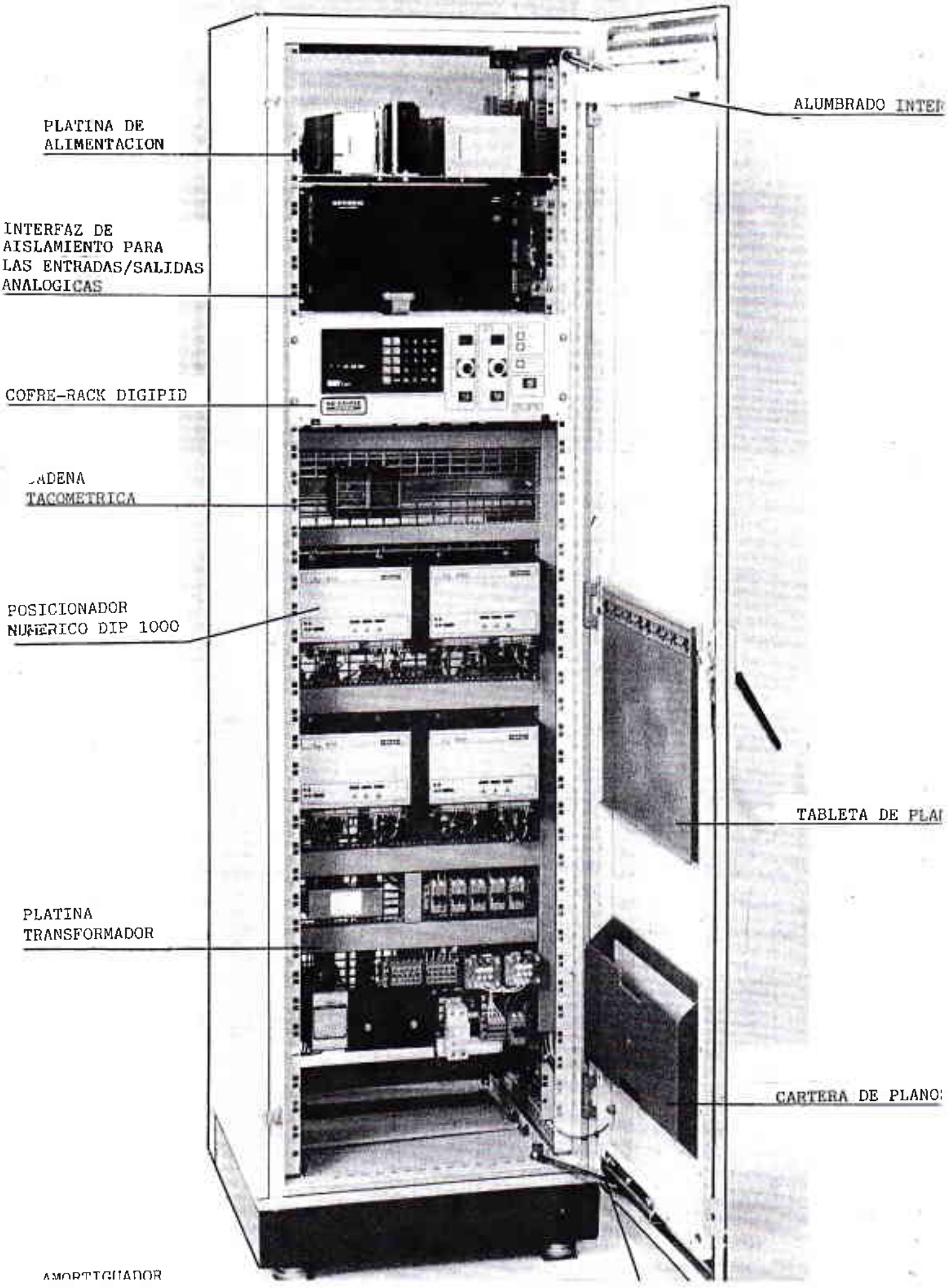
RENOVACION PRESA
Y CENTRAL HIDROELECTRICA
Dr GABRIEL TERRA

ELEMENTOS MANTENIDOS

TUBERIAS DE PRESION CONSTANTE
TUBERIAS DE PILOTAJE
TUBERIAS DE DESCARGA
TUBERIAS DE FUGA

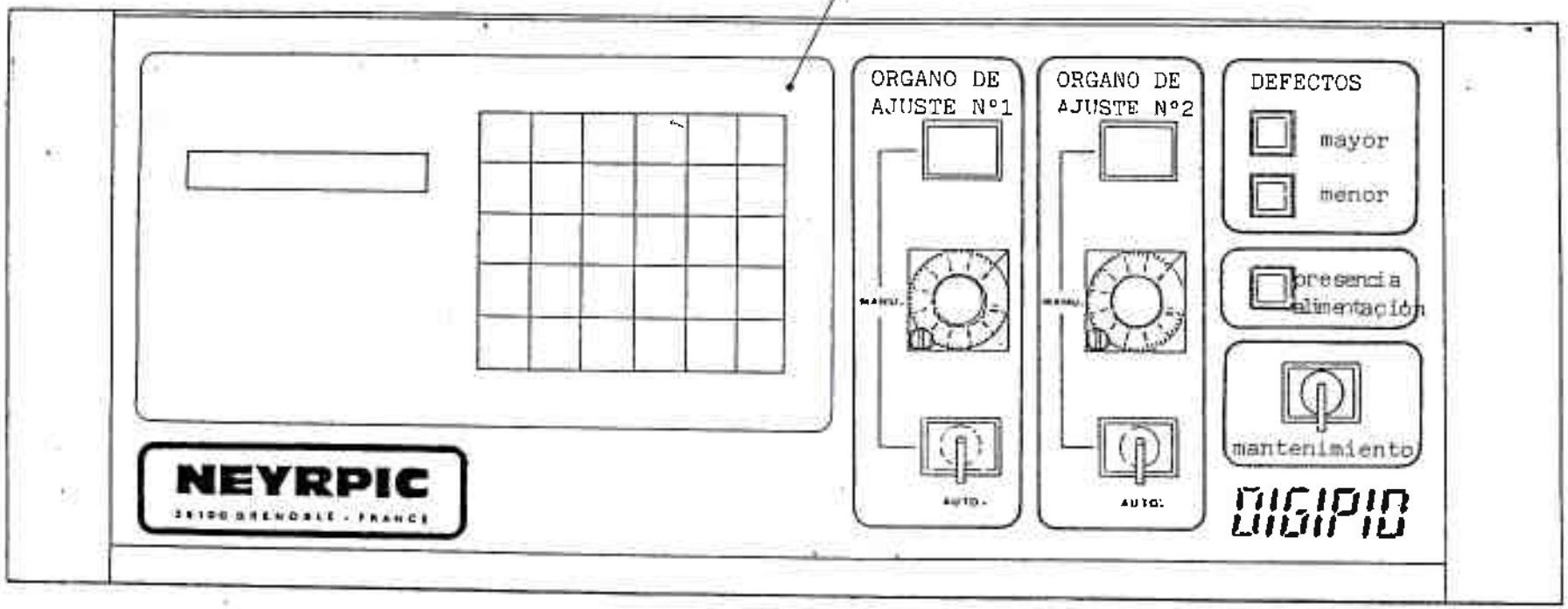
ESQUEMA DE REGULACION	Nº PLANO
SCHEMA DE REGULATION	
COORDINADOR: SACEEM	
CONSORCIO: Spie Batignolles - Sainrapt Neyrpic - Alsthom - Jeumont	ALSTHOM


Actuador TR 10
Filtro
Estación de aceite
Electrodistribuidor de seguridad
Adaptación detector
A
C
Válvula distribuidora
Cierre de seguridad
Frecuencia Red
Velocidad Grupo
COFRE ELECTRONICO
± carga
Alimentación
Caja de Retroalimentación
A
C
Servomotor


PLATINA DE ALIMENTACION
INTERFAZ DE AISLAMIENTO PARA LAS ENTRADAS/SALIDAS ANALOGICAS
COFRE-RACK DIGIPID
CADENA TACOMETRICA
POSICIONADOR NUMERICO DIP 1000
PLATINA TRANSFORMADOR
AMORTIGUADOR
ALUMBRADO INTE
TABLETA DE PLA
CARTERA DE PLANO

F02

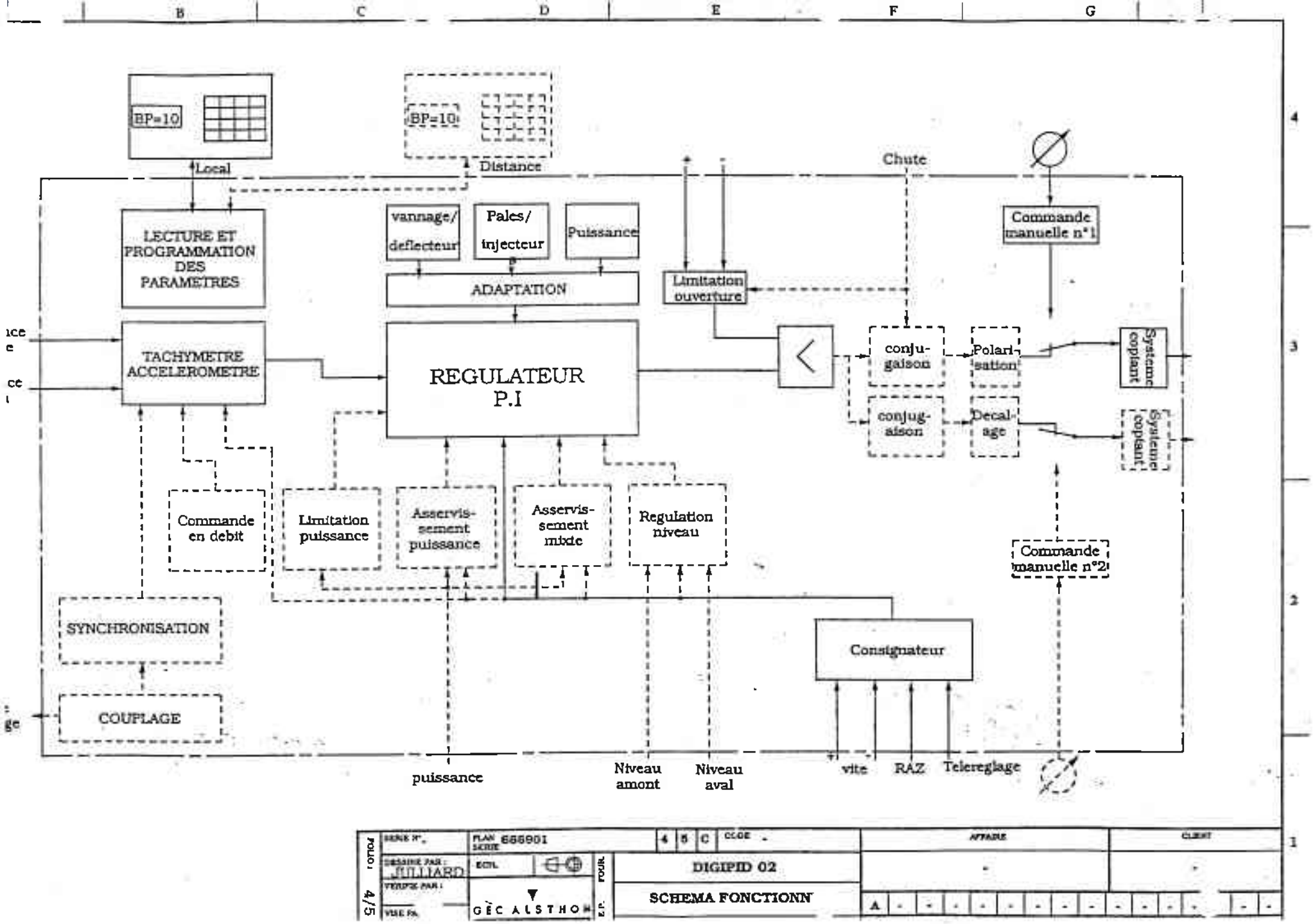
CARA DELANTERA

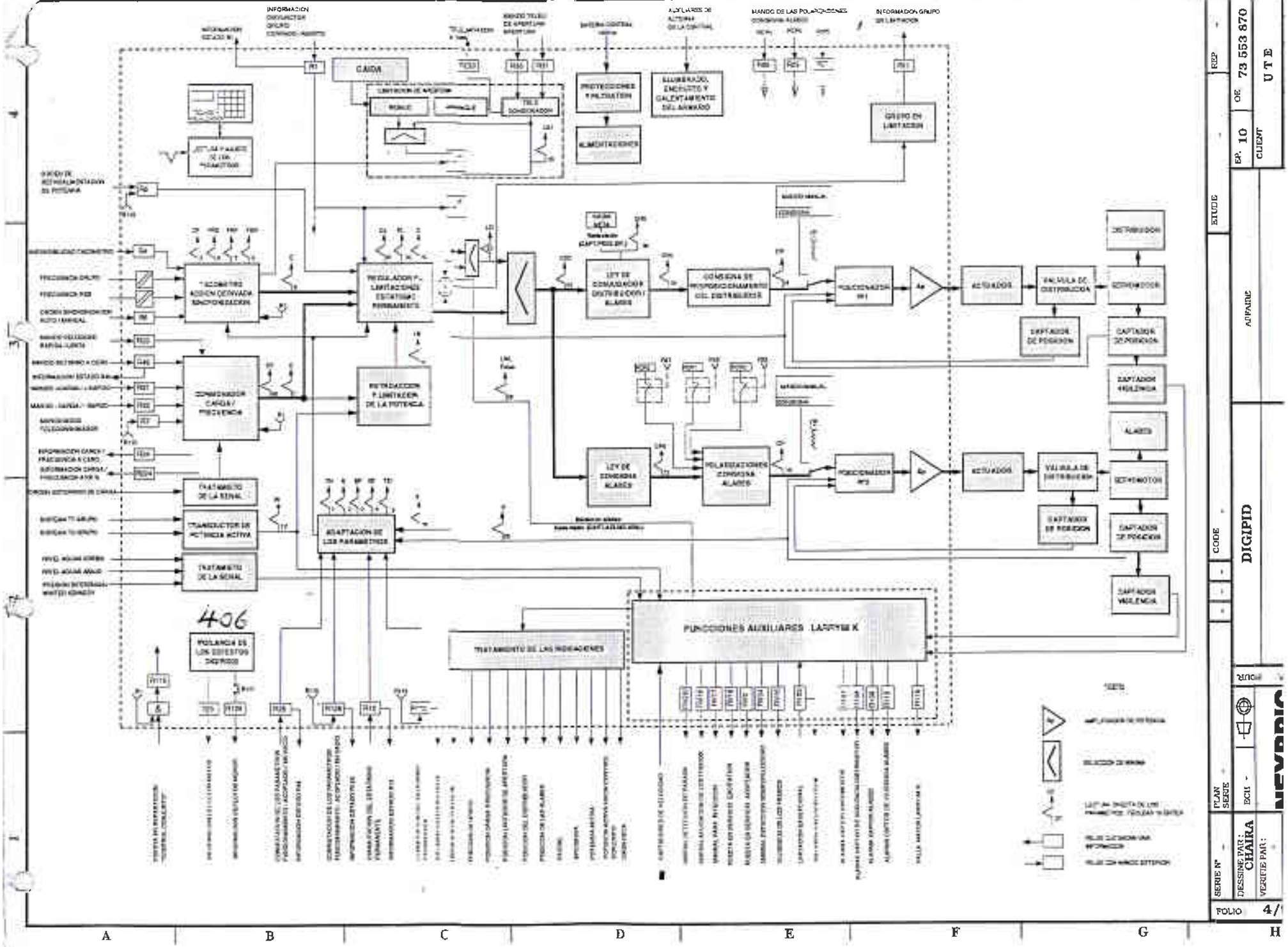


DIGIPID

Code 0.346.121.000.0 | ETUDE | O.E. | DATE | VISA | N.P. | REP. | MODIFICATIONS

Nº | PLAN SERIE 6654031 | ECH. 4/3 | DESSINE PAR | Fol.


B
C
D
E
F
G
4
3
2
1
BP=10
Local
BP=10
Distance
Chute
LECTURE ET PROGRAMMATION DES PARAMETRES
vannage/ deflecteur
Pales/ injecteur
Puissance
ADAPTATION
Limitation ouverture
Commande manuelle n°1
TACHYMETRE ACCELEROMETRE
REGULATEUR P.I
conju- gaison
Polari- sation
Systeme copiant
conjug- aison
Decal- age
Systeme copiant
Commande en debit
Limitation puissance
Asservis- sement puissance
Asservis- sement mixte
Regulation niveau
Commande manuelle n°2
SYNCHRONISATION
Consignateur
COUPLAGE
puissance
Niveau amont
Niveau aval
vite
RAZ
Telereglage
FOLIO 4/5
DESSINE PAR : JULLIARD
VERIFIE PAR :
VISE PA
PLAN SERIE 666901
4 5 C
CODE -
ECHL
GEC ALSTHOM
FOUR.
E.P.
DIGIPID 02
SCHEMA FONCTIONN
AFFAIRE
CLIENT
A


406
DIGIPID
FUNCIONES AUXILIARES LARYMK
TRATAMIENTO DE LAS INDICACIONES
CAIDA
REGULACION P. LIMITACIONES ESTATISMO PERMANENTE
REGULACION P LIMITACION DE LA POTENCIA
ADAPTACION DE LOS PARAMETROS
ACTUADOR
VALVULA DE DISTRIBUCION
DISTRIBUIDOR
CAPTADOR DE POSICION
CAPTADOR DE PRESION
CAPTADOR VIBRATORIO
ALARMA
SERVOMOTOR
TRATAMIENTO DE LA SEÑAL
TRANSDUCTOR DE POTENCIA ACTIVA
ADAPTACION DE LOS PARAMETROS
CONMUTADOR CARGA / FRECUENCIA
ADAPTACION DE LOS PARAMETROS
ALIMENTACIONES
ILUMINACION, ENCHUFES Y CALENTAMIENTO DEL ARMARIO
GRUPO EN LIMITACION
PROTECCIONES Y PILOTAGES
CHIARA
UTE
73 553 870
EP. 10
ADAPARC
ETUDE
CODE
PLAN SERIE
SERIE N°
FOLIO 4/

CONTROL NUMERICO (5V)

CONTROL ANALOGICO (24V)

DIGITAL

CONEXIONADO NORMAL

"STAR" PC COMPAQ

PARA LECTURA DE ESTADOS

TECLADO DIGITO

REMARQUE : IL N'EXISTE PAS DE PROGRAMME DE TEST DE LA CARTE ICC DANS "MAINTENANCE"

CI 405

CARA DELANTERA

CARA TRASERA

J26

J25

J24

J23

J22

J21

J20

CI 3811 TARJETA MAESTRA BUS G 64

CI 5911 TARJETA MAESTRA ANALOGICA

TABLINE TRIO

CPU RAM

EEPROM

DIGITAL ⇄ ANALOGICO

ANALOGICO/DIGITAL

ANALOGICO/DIGITAL

CONTADOR ALARGAS

CONTADOR DISTRIBUIDOR

MANDO DISTRIBUIDOR

CONTADOR ALARGAS

MANDO ALARGAS

E/S TODO/NADA

E/S

E/S

DIGIPID

RACK DIGIPID

INTERCONNEXION DES LOS CABLES
PLANOS + OPCION STATUS

NEVRPIC

02/01/90

STG

867889

BAIE

PLAN

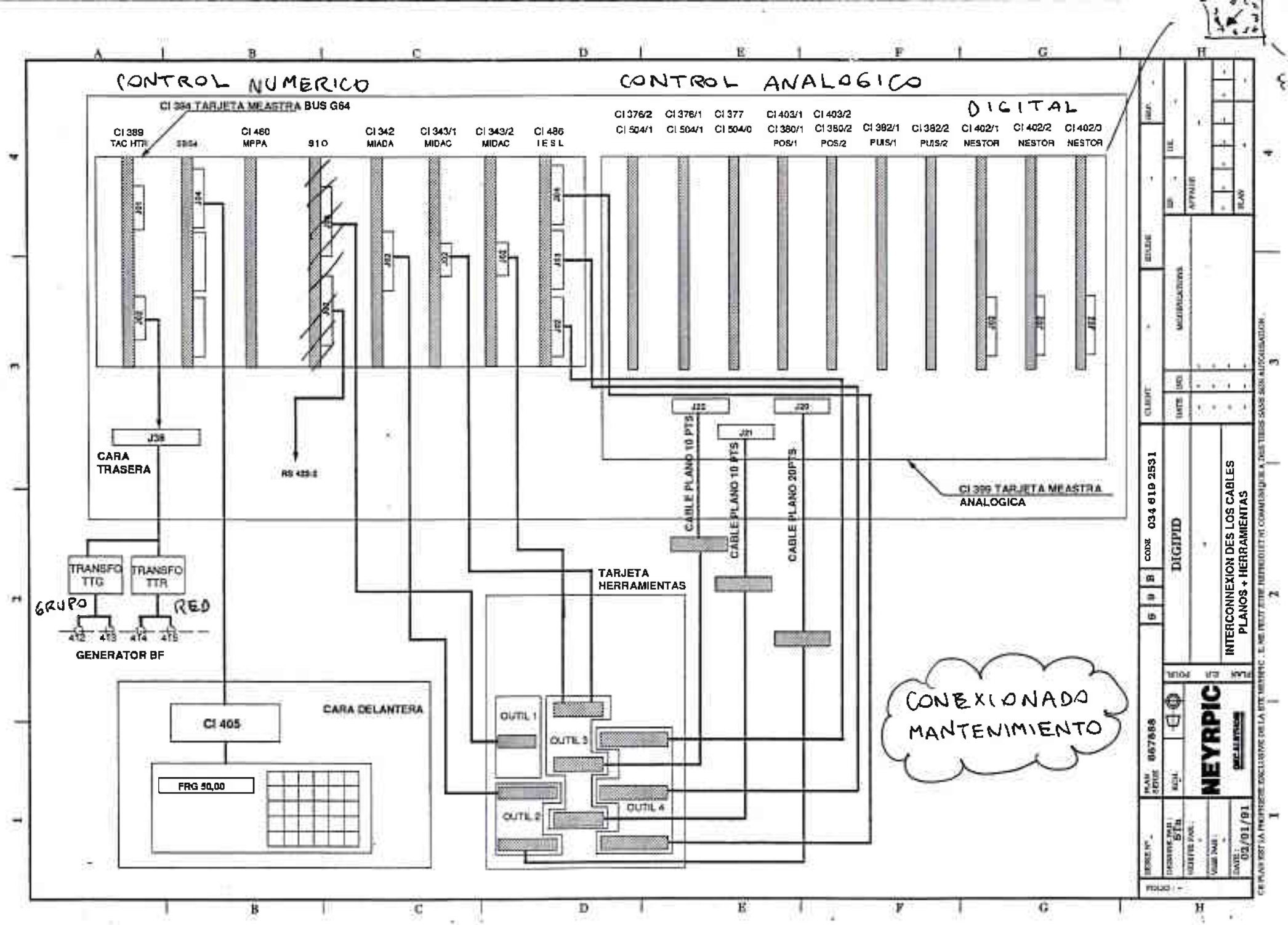
FOLIO -

REF. - ETUDE - CLIENT - CODE B 9 A

DP. - DE. - APPAREIL - MODIFICATIONS - IND - DATE

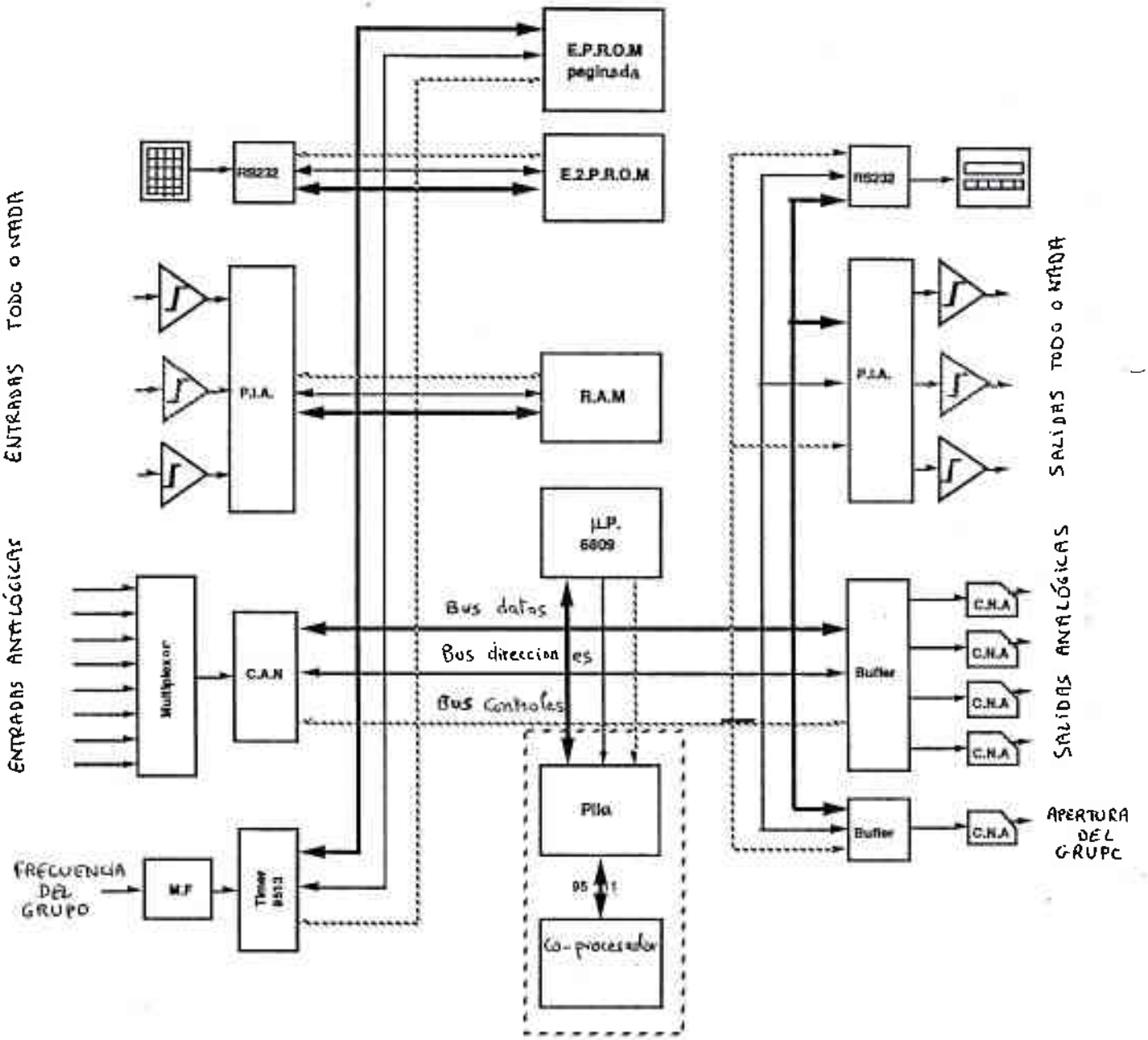
PLAN -

CE PLAN EST LA PROPRIETE EXCLUSIVE DE LA SFIE NEVRIC . IL NE PEUT ETRE REPRODUIT NI COMMUNIQUE A DES TIERS SANS SON AUTORISATION


CONTROL NUMERICO
CONTROL ANALOGICO
DIGITAL
CI 394 TARJETA MEASTRA BUS G64
CI 389 TAC HTR
CI 460 MPPA
910
CI 342 MIADA
CI 343/1 MIDAC
CI 343/2 MIDAC
CI 486 IESL
CI 376/2 CI 504/1
CI 376/1 CI 504/1
CI 377 CI 504/0
CI 403/1 CI 380/1 POS/1
CI 403/2 CI 380/2 POS/2
CI 382/1 PUIS/1
CI 382/2 PUIS/2
CI 402/1 NESTOR
CI 402/2 NESTOR
CI 402/3 NESTOR
J38
CARA TRASERA
RS 422-2
CABLE PLANO 10 PTS
CABLE PLANO 10 PTS
CABLE PLANO 20PTS
CI 399 TARJETA MEASTRA ANALOGICA
TRANSFO TTG
TRANSFO TTR
GRUPO
RED
GENERATOR BF
TARJETA HERRAMIENTAS
OUTIL 1
OUTIL 3
OUTIL 2
OUTIL 4
CARA DELANTERA
CI 405
FRG 50,00
CONEXIONADO MANTENIMIENTO
DIGIPID
INTERCONNEXION DES LOS CABLES PLANOS + HERRAMIENTAS
NEYRPIC
02/01/91

Regulador de velocidad:

Aspectos materiales:



SBS4

- 2 ROMs RAM
- PROGRAMA (ROM)
+ 4 ROM en MPPA

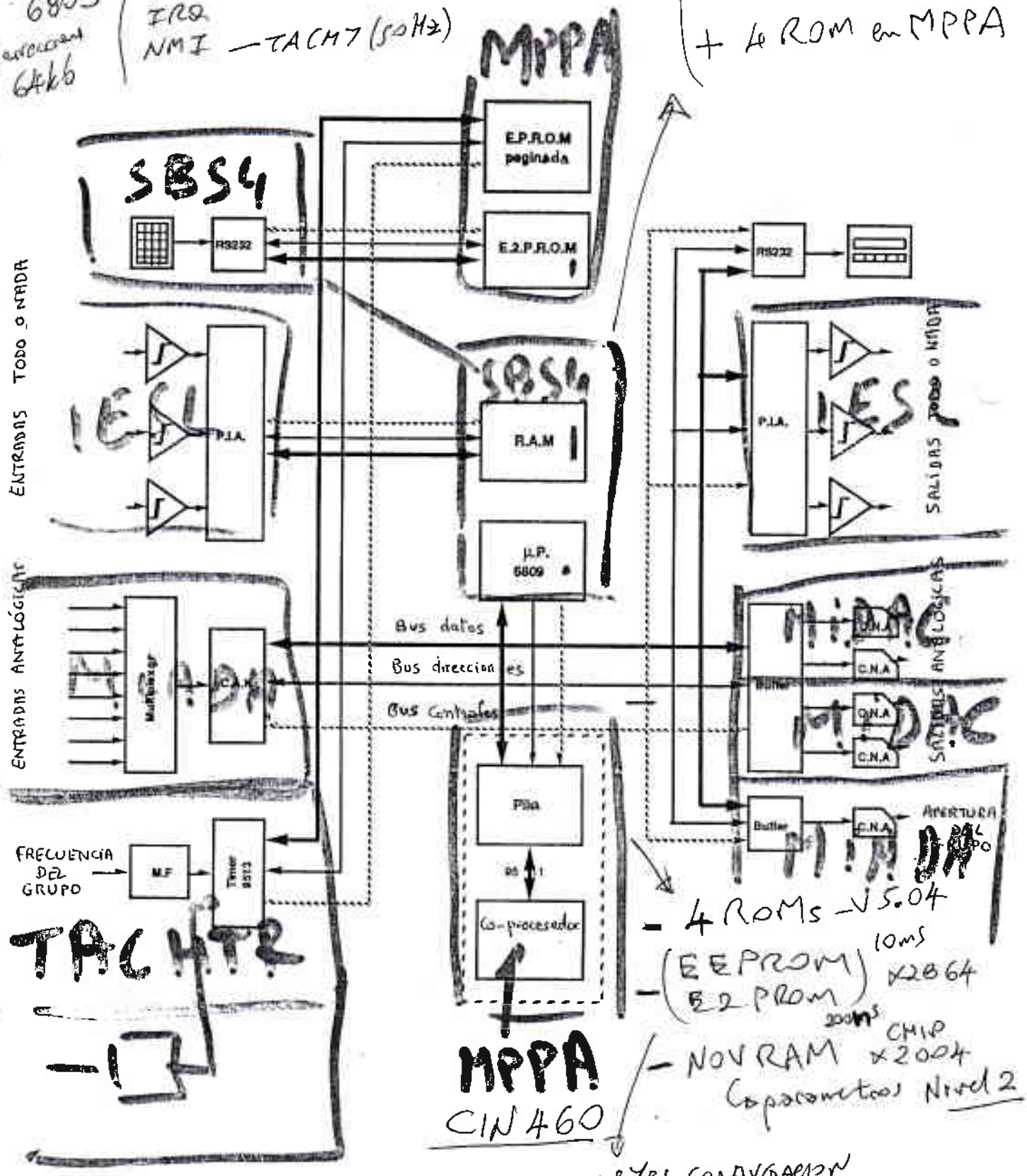
Regulador de velocidad:

Aspectos materiales:

6809 Direccion 64kb

FIRQ
IRQ
NMI

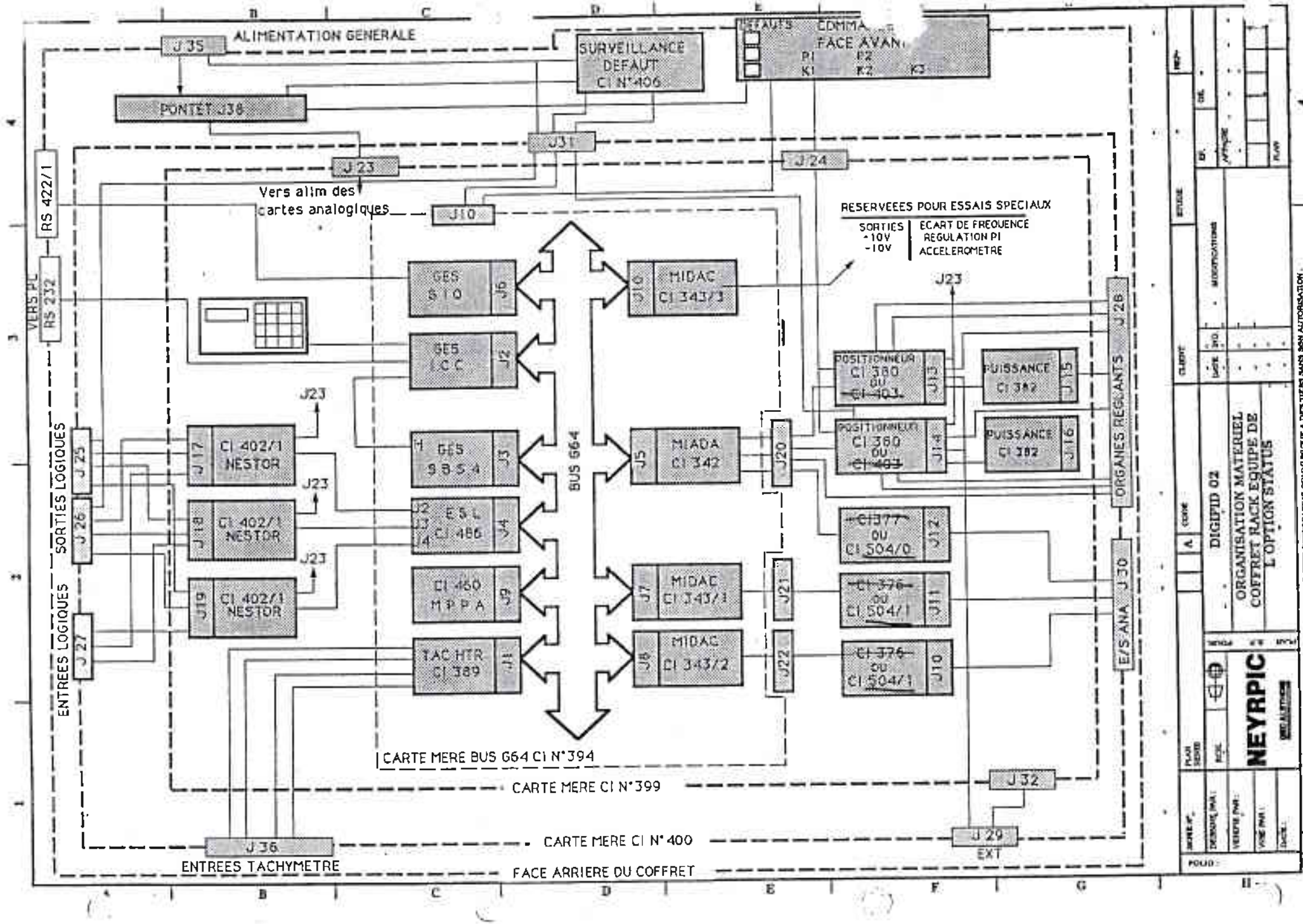
— TACH 7 (50Hz)



- 4 ROMs — V5.04
- (EEPROM) E2PROM 10ms x2864
- NOVRAM CMOS x2004 200ns
Capacimetros Nivel 2

— LEYES CONVOCACION
— NIVEL 3

sample time = 5ms
PID time = 100ms



CE PLAN EST LA PROPRIETE EXCLUSIVE DE LA STE NEYRPIC. IL NE PEUT ETRE REPRODUIT NI COMMUNIQUE A DES TIERS SANS SON AUTORISATION.

Technological study of a numerical governor

This chapter describes in turn :

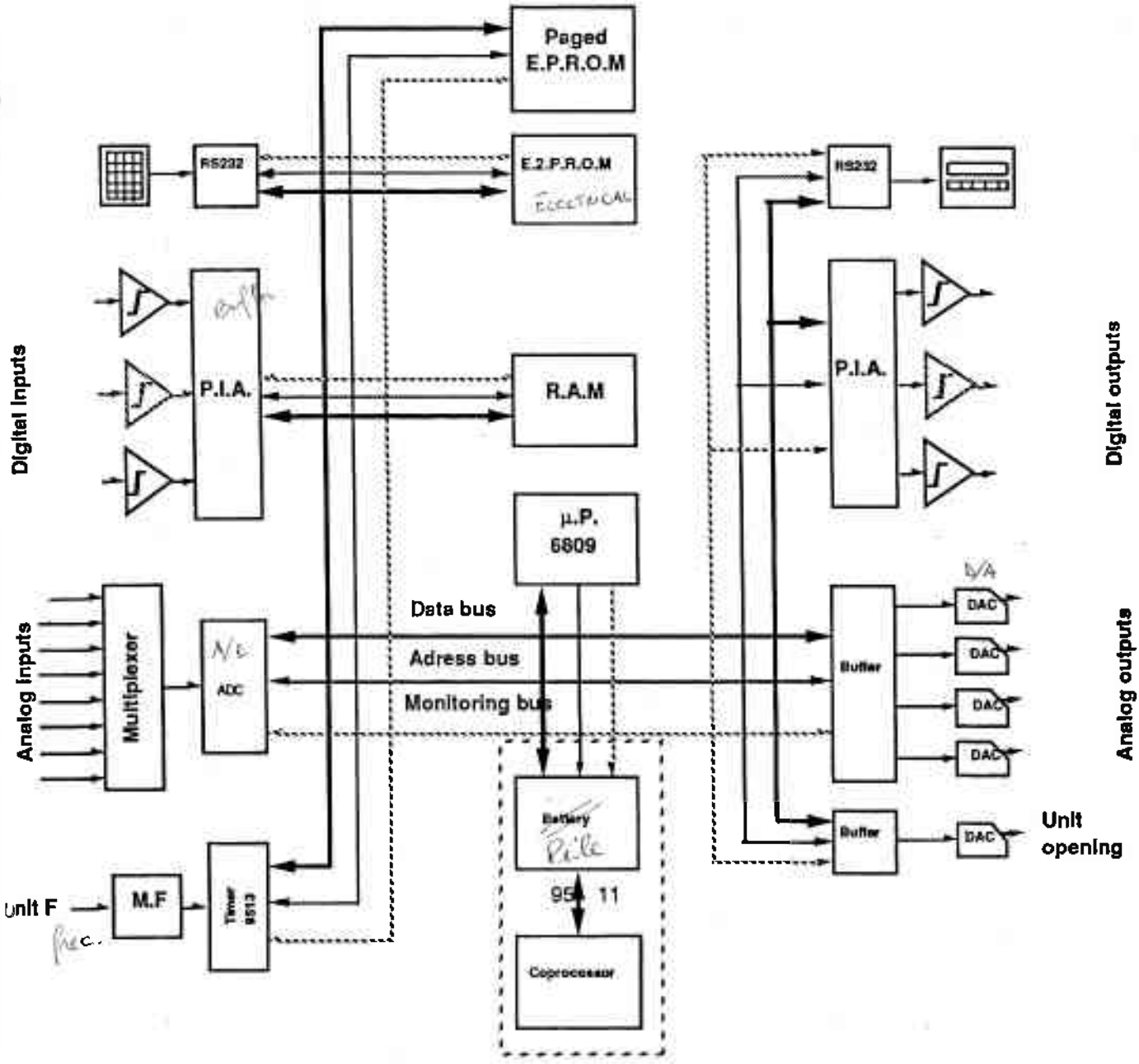
- The hardware organization of the numerical governor :
unlike analog governors, there is no direct correlation between this structure and the signal processing performed. visualization of external and internal variable values provides little information of use for maintenance purposes test program has thus been developed.

- The software organization :
The application program is subdivided into tasks. Management of these tasks by the "real time monitor" allows optimization of calculation times.

- The (analog) positioner and its power stage (cut up).

The speed governor

Hardware aspects :



The calculations are performed by :
- µ.P 6809 (general calculations)
- 9511 floating processor (arithmetic calculations) working under an interruption mask :
- data are exchanged via a battery. The bus is thus free for the duration of the arithmetic calculation.

Various types of memories are used according to the information to be stored.

(E)PROM : this paged memory contains the application program
Its content cannot be modified when it is applied.

E2PROM, NOVRAM : these memories contain the data specific to the application : parameters and constants.
This information is preserved when the power supply is cut.
Modification of their content requires a specific procedure implemented by access to operating level 2.
RAM : These memories contain the result of the acquisitions of external variables and of the intermediate calcula
Their content is constantly modified and lost when power is cut.

The interfaces are divided up as follows :
- acquisition (or input) interfaces : these convert external data or variable information into parallel binary codes identifiable by the µP, namely :
- serial interfaces : connection to keyboard, printer, computers...
- parallel interfaces : digital signals
- analog interfaces (measuring external variables)
- the tachometer which measures the period of an alternating signal.

- the output interfaces allowing external restitution of the numerical processing results, namely :
- serial interfaces : connection to displays, printer, computers,...
- parallel interfaces : digital signals
- analog interfaces

Exchange of data between the µP and its peripherals :
input or output interfaces or memories takes place according to the same process.

All the necessary information flows on a bus connecting the peripherals and the µP to each other,

- the data (values or operating codes) are coded in the form of octets (8 bits),
- the addressee or sender is identified by an address (16 bits),
- data transfer management (timing) is ensured by the check bits.

Implementation :
The DIGIPID 02 is organized around three mother boards :
- the G64 bus
- the interface board (CI 399)
- the connector board (inputs outputs - CI 400).

The interconnections are made
- between the bus and interface : by flat cables from board to board or to connectors J20, J21, J22,
- between the interface and the connectors : by three flexible circuits.

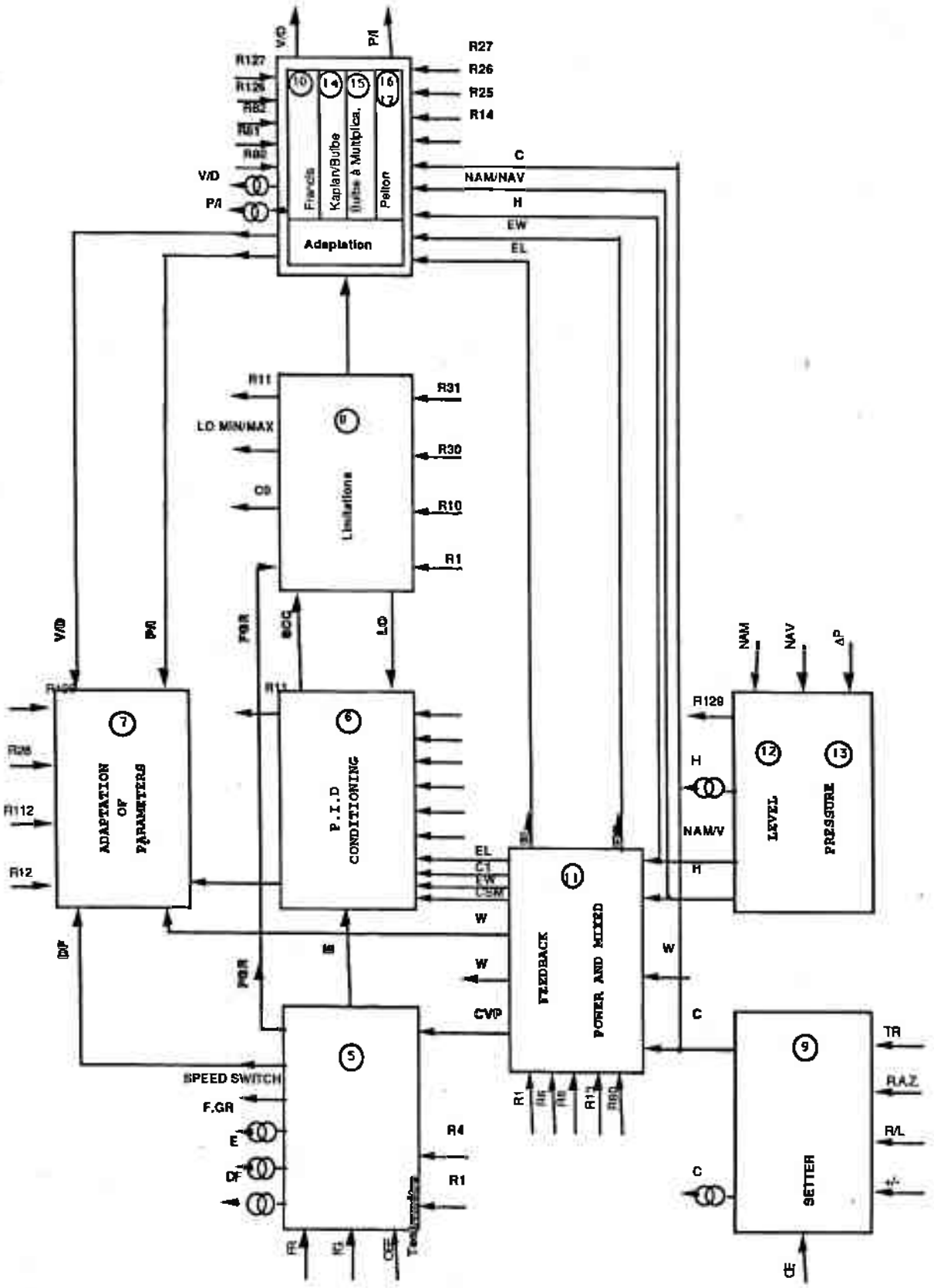
The cabinet houses a minimum number of cables : power supplies, unit and grid voltage transformer, dialogue cons

The voltage supervision board ensures power supplies remain within preset limits.

Software organization

The operating software is subdivided into tasks :

Each task is described in the attached document "Functional Diagrams" in the form of an organization chart. The shows the functional interaction between the tasks and refers to the corresponding functional diagram sheet (N° si by a circle).

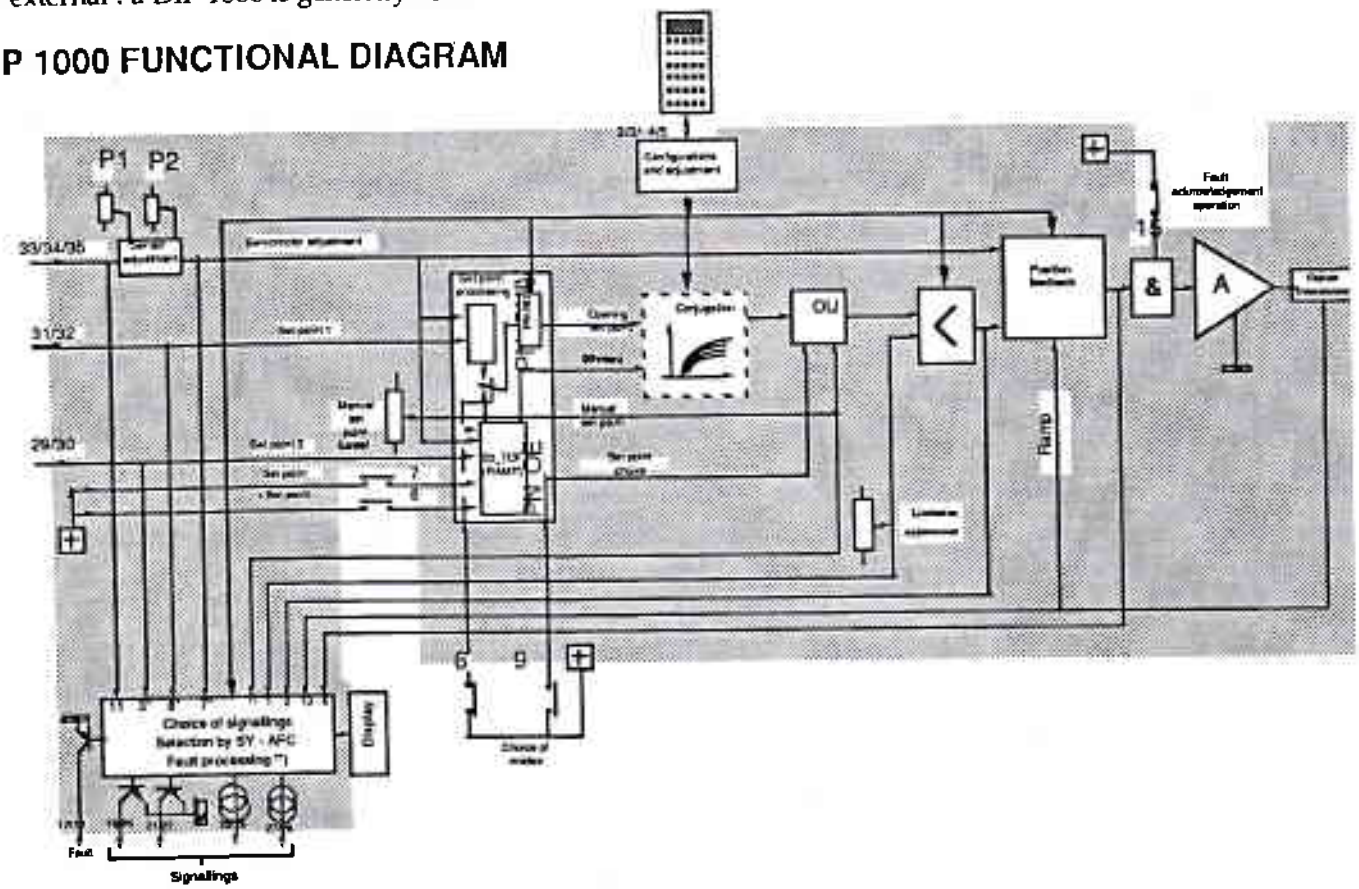


The positioner stage :

According to the case, this stage may be :

- internal : it then consists of two analog boards:
- or external : a DIP 1000 is generally used.

DIP 1000 FUNCTIONAL DIAGRAM



The internal positioner :
it is made up of :

a feedback board which :
- supplies the servomotor and distributor position sensors
- shapes this information:
  conversion, scaling
- mechanically compensates on opening and closing
- controls the power stage (switching)

a power board (H-bridge)

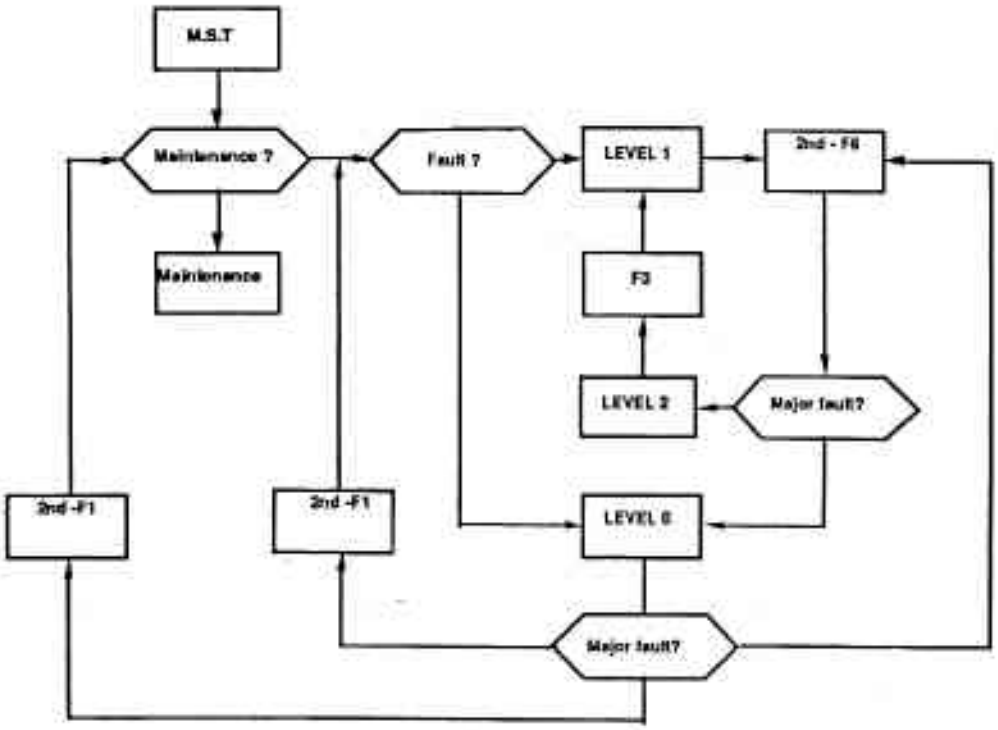
Two types of feedback board are compatible with the DIGIPID 02 corresponding to the type of position measurement
adopted :

- the "variometer" board contains
an alternating variometer supply
the corresponding demodulator stages

- the "inductive sensor" board contains a sensor fault detection by absence of zero signal current
This detection gives rise to a major fault (relay R29) and a unit closing order at board level.

Operating and maintenance procedures

The operation levels :



The operating levels can be divided up into three categories, namely :

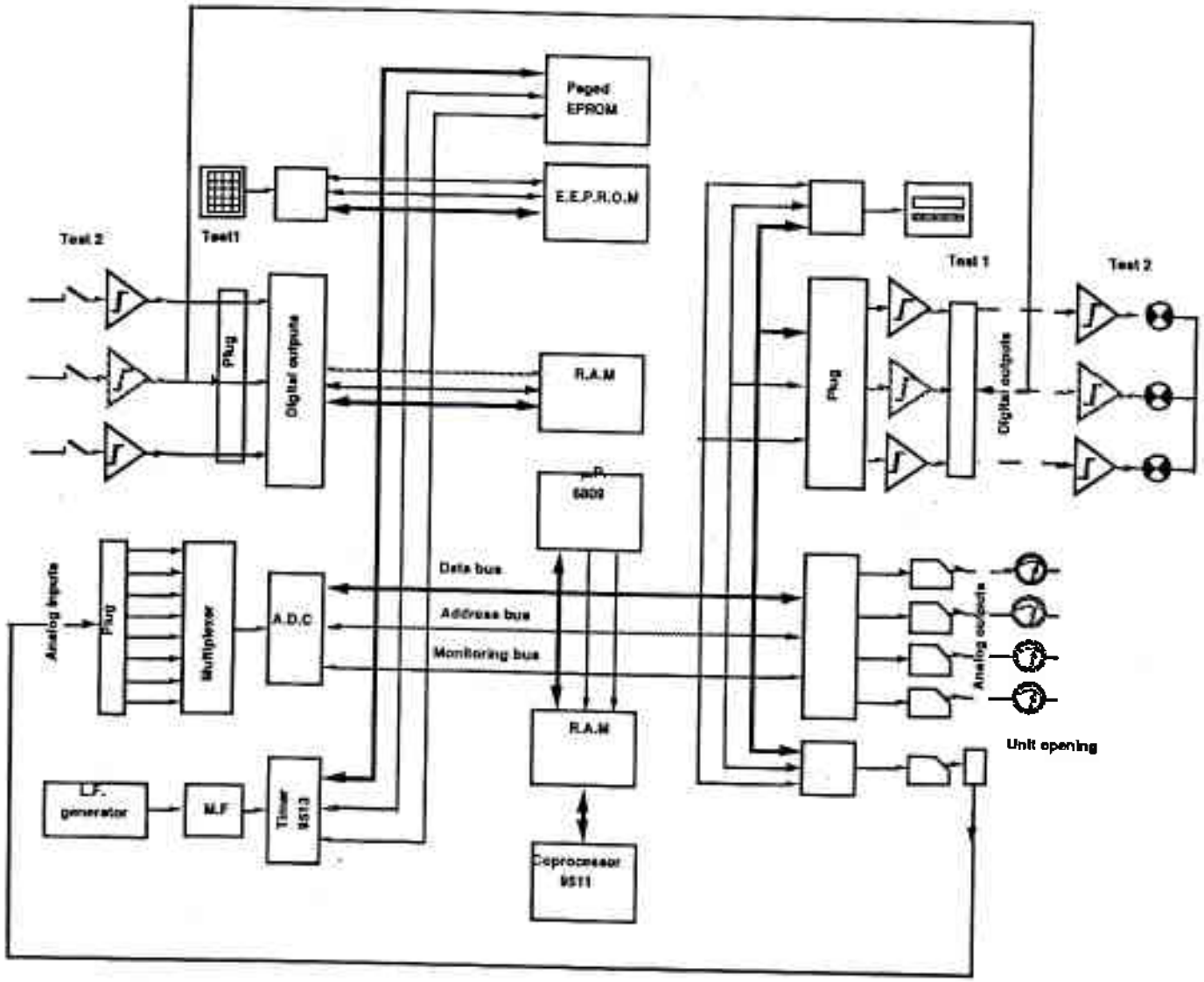
- Level 1
Function :
- this is the current operating level. It allows visualization of the active values of the parameters and the main external and internal variables.
Access :
Automatic on switching on
By key F3 on the keyboard from level 2 (return to starting level)
By acknowledgement (2Nd + F1 = return to level preceding the fault) or by the "maintenance" key from level 0.

- Level 2
Function :
- Modification of certain constants and parameters of the current governor
- Monitoring options
Access :
By 2Nd + F6 (from level 0 or 1)
By acknowledgement (2Nd + F1 = return to level preceding the fault).

- Level 0
Function :
- Display of fault message
- Validation of fault relay R29 (major fault), or R129 (minor fault).
Access :
Automatic in case of fault detected by the on line maintenance program
By key F3 on the keyboard from level 2 (return to starting level).

- Major fault :
This causes the unit to shut down (Relay R29)
- Minor fault :
This is reported (Relay R129) and automatically selects a degraded operating sequence.

Test method for the digital part of the DIGIPID 02 :



- Internal tests :

µ.P 6809 - The various operating codes are applied to operands previously stored in memory. The result of each operation is compared with its theoretical result.

Floating processor 9511 - the above test is performed.
It is completed by a precision test for low weights (iterative calculation)
(E)PROM : the memory is tested by the checksum calculation (sum of the binary value of all the octets). This sum is compared with the initial value.
RAM : Defined binary codes are written in the memory.
They are monitored after their content has been reread.
E2PROM : two tests are performed in turn :
- the memory is tested by the checksum calculation (sum of the binary value of all the octets). This sum is compared with the inital value,
defined binary codes are written in the memory,
they are monitored after their content has been reread.
Important : during this test the content of the E2PROM is saved: do not cut power or actuate the "maintenance" key.

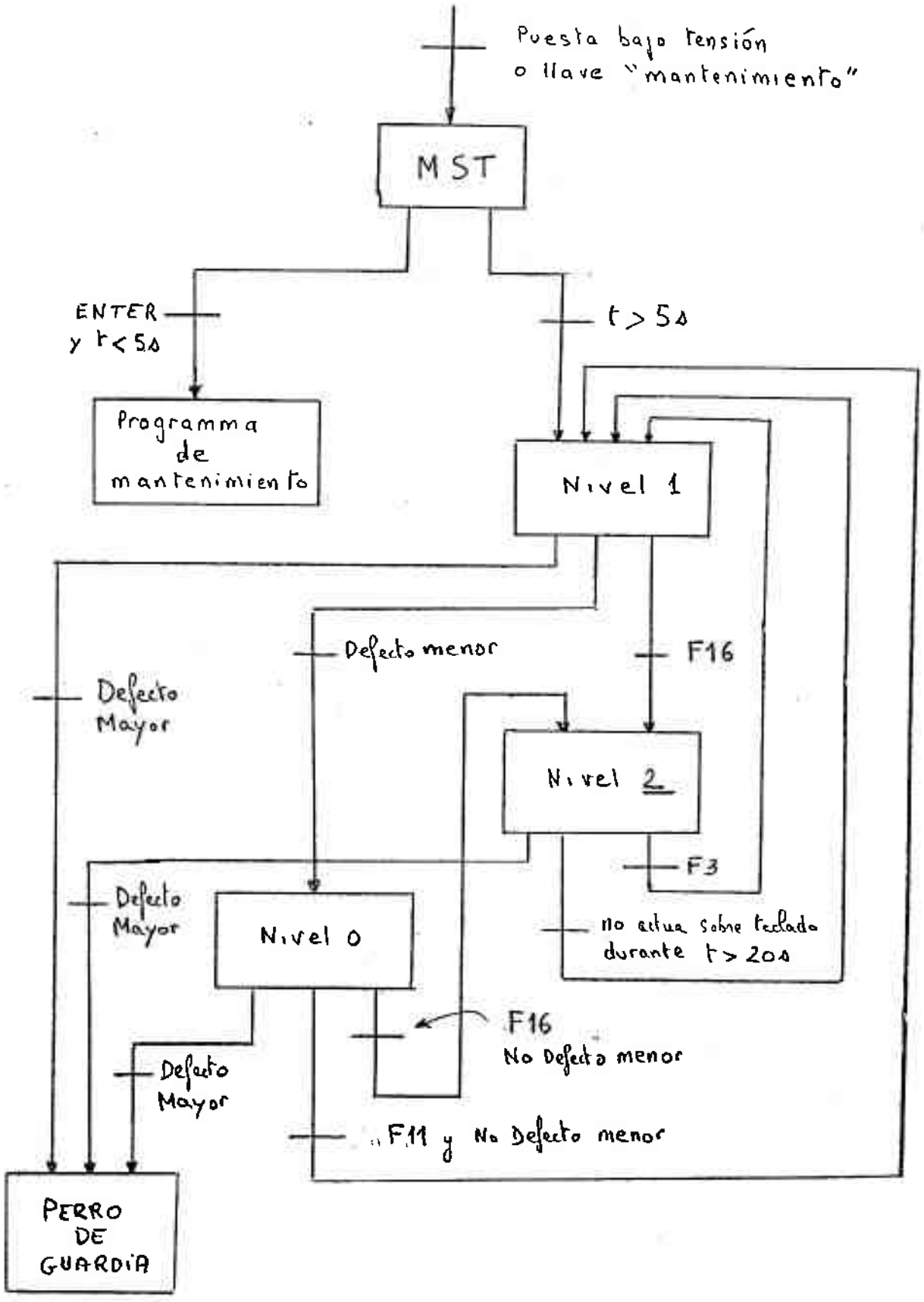
Input interfaces :
Serial interface : the operator writes a list of characters on the peripheral keyboard which the µP restores on the display. This test is performed after the serial output test.
Parallel interfaces : 2 tests are performed :
- the parallel input and output interfaces are connected to each other by a plug.

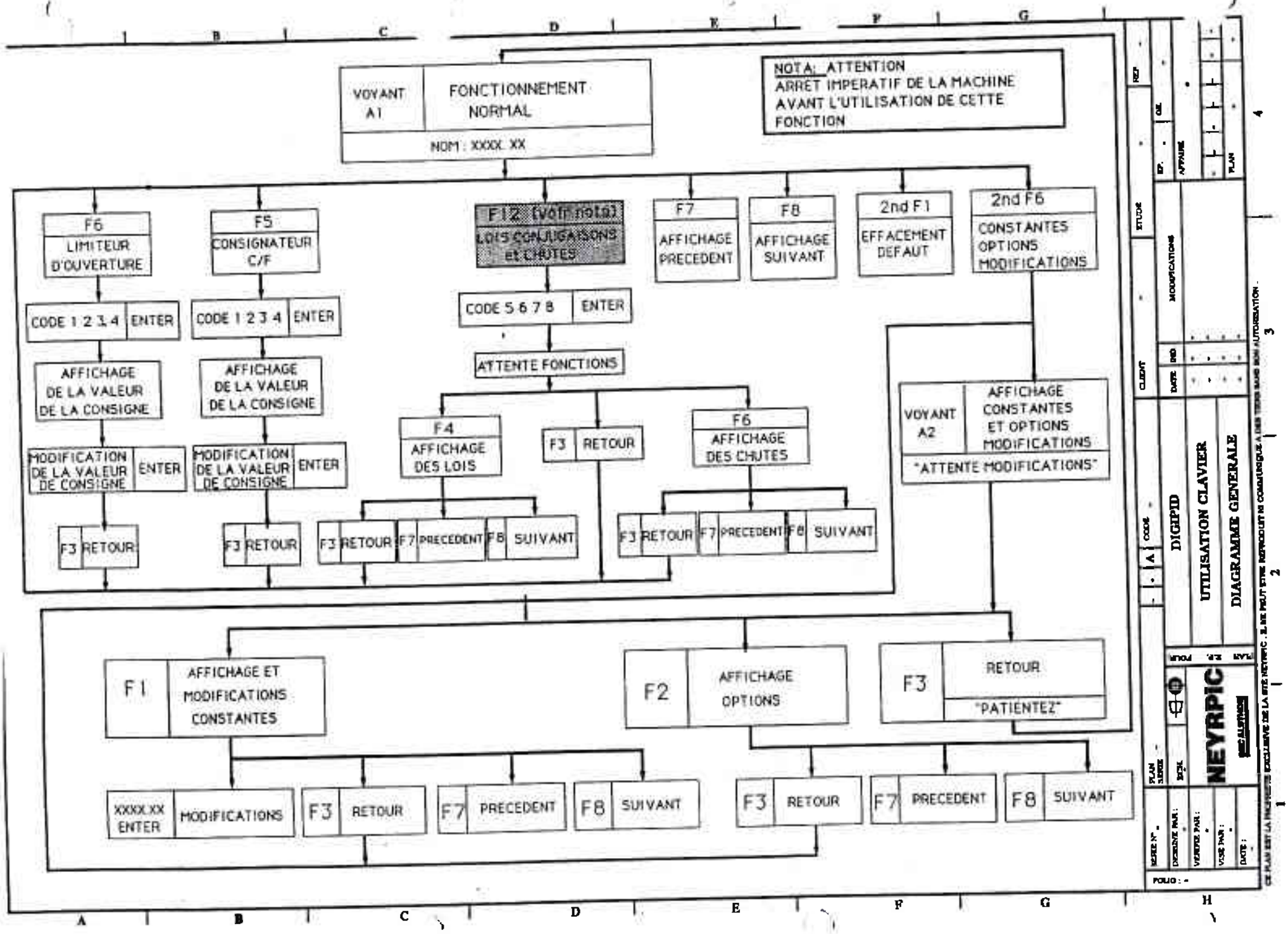
The µP monitors on its inputs the binary codes transmitted to the outputs (in the event of faulty re-reading, the output is maintained in the state which caused the fault)
The logic levels are introduced by the operator (by means of switches)
The information received is restored on the display.
Analog input interfaces and the two outputs of board MIADA are connected to each other by a plug.
The µP monitors on its inputs the voltage values (Vmin, Vmean, Vmax) transmitted to the outputs.
(in the event of faulty re-reading, the output is maintained in the state which caused the fault).
Tachometer : The unit and grid frequencies are introduced by means of external generators.
The operator can monitor the corresponding information and the unit/grid phase shift on the display.

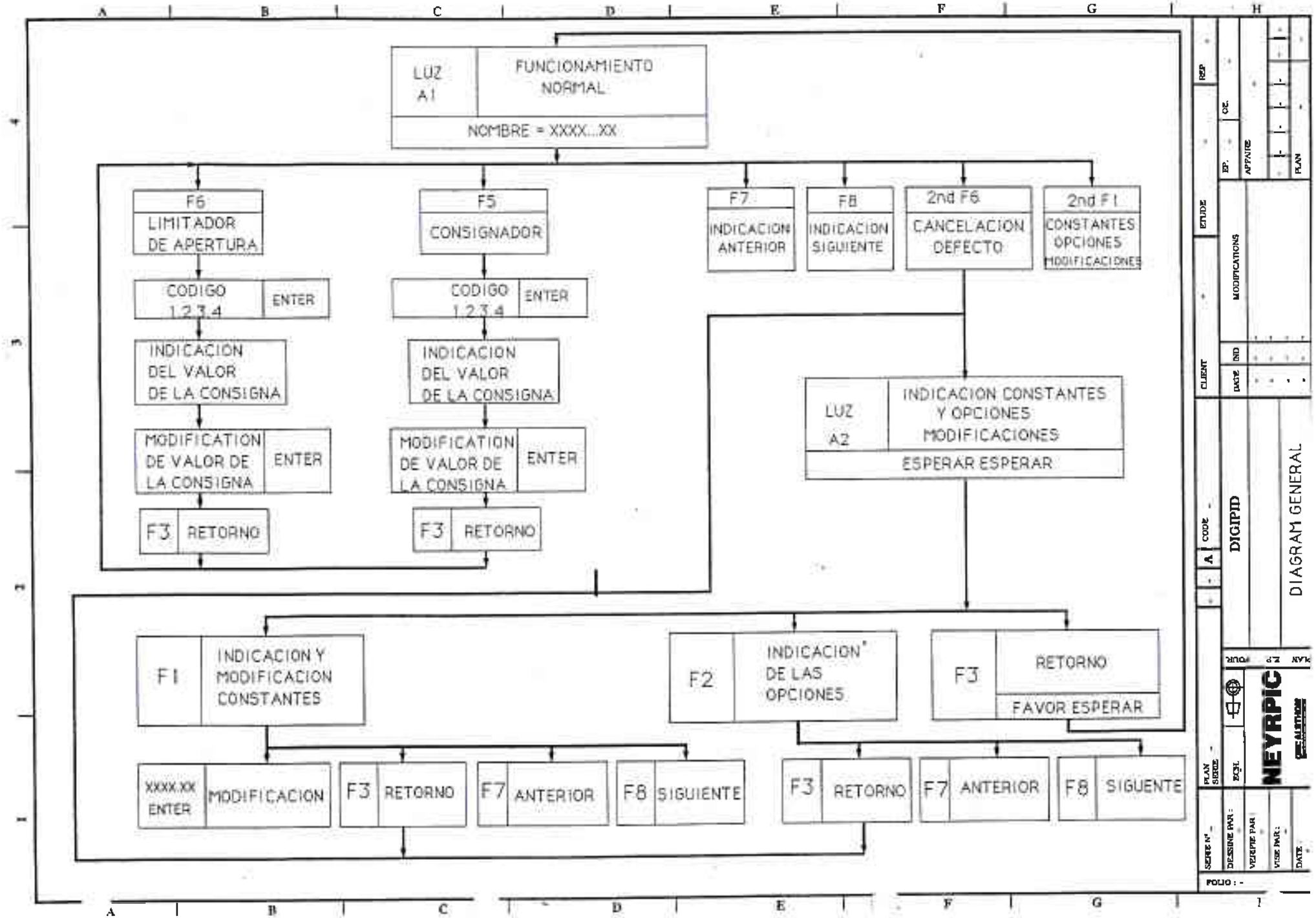
- the output interfaces :
Serial interfaces : the µP transmits the ASCII code characters to the peripheral.
The operator confirms the validity of the transmission. This test is performed before the serial input test.

Parallel interfaces : 2 tests are performed :
the parallel input and output interfaces are connected to each other by a plug.
The µP monitors on its inputs the binary codes transmitted to the outputs (in the event of faulty re-reading, the output is maintained in the state which caused the fault).
The operator uses the keyboard to assign a logic level to each output.
Monitoring can be performed by indicator lights.
Analog interfaces : the two outputs of board MIADA and the analog input and output interfaces are connected to each other by a plug.
The µP monitors on its inputs the voltage values (Vmin, Vmean, Vmax) transmitted to the outputs. (in the event of faulty re-reading, the incorrect voltage is stored on the output).
The operator uses the keyboard to assign an analog level to each output of boards MIDAC.
Monitoring can be performed by a voltmeter.

Niveles de explotación




VOYANT A1
FONCTIONNEMENT NORMAL
NOM : XXXX. XX
NOTA: ATTENTION ARRET IMPERATIF DE LA MACHINE AVANT L'UTILISATION DE CETTE FONCTION
F6 LIMITEUR D'OUVERTURE
F5 CONSIGNATEUR C/F
F12 (voir note) LOIS CONJUGAISONS et CHUTES
F7 AFFICHAGE PRECEDENT
F8 AFFICHAGE SUIVANT
2nd F1 EFFACEMENT DEFAUT
2nd F6 CONSTANTES OPTIONS MODIFICATIONS
CODE 1 2 3 4 ENTER
CODE 1 2 3 4 ENTER
CODE 5 6 7 8 ENTER
AFFICHAGE DE LA VALEUR DE LA CONSIGNE
AFFICHAGE DE LA VALEUR DE LA CONSIGNE
ATTENTE FONCTIONS
MODIFICATION DE LA VALEUR DE CONSIGNE ENTER
MODIFICATION DE LA VALEUR DE CONSIGNE ENTER
F4 AFFICHAGE DES LOIS
F3 RETOUR
F6 AFFICHAGE DES CHUTES
VOYANT A2
AFFICHAGE CONSTANTES ET OPTIONS MODIFICATIONS
"ATTENTE MODIFICATIONS"
F3 RETOUR
F3 RETOUR
F3 RETOUR F7 PRECEDENT F8 SUIVANT
F3 RETOUR F7 PRECEDENT F8 SUIVANT
F1 AFFICHAGE ET MODIFICATIONS CONSTANTES
F2 AFFICHAGE OPTIONS
F3 RETOUR "PATIENTEZ"
XXXX.XX ENTER MODIFICATIONS
F3 RETOUR
F7 PRECEDENT
F8 SUIVANT
F3 RETOUR
F7 PRECEDENT
F8 SUIVANT
DIGIPID
UTILISATION CLAVIER
DIAGRAMME GENERALE
NEYRPIC
CE PLAN EST LA PROPRIETE EXCLUSIVE DE LA SITE NEYRPIC. IL NE PEUT ETRE REPRODUIT NI COMMUNIQUE A DES TIERS SANS NOTRE AUTORISATION.


LUZ A1
FUNCIONAMIENTO NORMAL
NOMBRE = XXXX...XX
F6
LIMITADOR DE APERTURA
CODIGO 1,2,3,4
ENTER
INDICACION DEL VALOR DE LA CONSIGNA
MODIFICATION DE VALOR DE LA CONSIGNA
ENTER
F3
RETORNO
F5
CONSIGNADOR
CODIGO 1,2,3,4
ENTER
INDICACION DEL VALOR DE LA CONSIGNA
MODIFICATION DE VALOR DE LA CONSIGNA
ENTER
F3
RETORNO
F7
INDICACION ANTERIOR
F8
INDICACION SIGUIENTE
2nd F6
CANCELACION DEFECTO
2nd F1
CONSTANTES OPCIONES MODIFICACIONES
LUZ A2
INDICACION CONSTANTES Y OPCIONES MODIFICACIONES
ESPERAR ESPERAR
F1
INDICACION Y MODIFICACION CONSTANTES
XXXX.XX ENTER
MODIFICACION
F3
RETORNO
F7
ANTERIOR
F8
SIGUIENTE
F2
INDICACION DE LAS OPCIONES
F3
RETORNO
F7
ANTERIOR
F8
SIGUENTE
F3
RETORNO
FAVOR ESPERAR
DIGIPID
DIAGRAM GENERAL
NEYRPIC

6.3.1. Lista de los defectos señalados

DENOMINATION	NATURALEZA	ACCION	PREPOSICION A FUNCIONAMIENTO NORMAL (Tras eliminarse el defecto)
PERRO DE GUA	Actuación del circuito de vigilancia del equipo fisico (defecto de desarrolo del programa)	R29 "defecto mayor" parada Unidad	- Inicialización (llave "mantenimiento" en el frente. - Arranque Unidad
TAQUI UNIDAD (Opción)	Defecto medida de velocidad Unidad : ▪ falta de medida ▪ médida errónea	R29 "defecto mayor" parada Unidad perro de guardia R129 "defecto menor"	- cancelación 2ndF1 - arranque Unidad - cancelación
TAQUI RED	Defecto medida re : - frecuencia < 90% de la frecuencia nominal - tensión < 80% de la tensión nominal	R129 "defecto menor" conmutación a sincro manual	- cancelación 2ndF1
DESBOR. CALCULO	Un resultado de cálculo aritmético queda fuera de los limites autorizados.	R129 "defecto menor" conmutación a sincro manual	- cancelación 2nd F1
DEFECTO RAM	Detección de un defecto de la memoria viva por la autoprueba	R29 "defecto mayor" parada Unidad perro de guardia	- inicialización - arranque Unidad
DEFECTO PROM	Detección de un defecto de la memoria muerta por la autoprueba.	R 29 "defecto mayor" parada Unidad perro de guardia	- inicialización - arranque Unidad

DENOMINATION	NATURALEZA	ACCION	PREPOSICION A FUNCIONAMIENTO NORMAL (Tras eliminarse el defecto)
DEFECTO 9511	Mal funcionamiento del procesador aritmético AM9511	R129 "defecto menor" Reinicialización auto. y prosecunormal. ó R29 "defecto mayor" parada Unidad perro de guardia (1)	- cancelación 2 nd F1 - inicialización - arranque Unidad
DEFECTO CDN	Defecto en una conversión analógica-numérica	R29 "defecto mayor" parada Unidad perro de guardia	- inicialización - arranque Unidad
DEFECTO EEPROM	Defecto en una conversión analógica-numérica	R129 "defecto mayor" parada Unidad perro de guardia	- inicialización - arranque Unidad
DEFECTO EEPROM	Detección por la autoprueba de un defecto en las memorias de almacenamiento de las constantes.	R29 "defecto mayor" parada Unidad perro de guardia	- inicialización - arranque Unidad
DEFECTO SOFT	Incoherencia en las informaciones de configuración.	R29 "defecto mayor" parada Unidad perro de guardia	- inicialización - arranque Unidad
DEFECTO UC	Detección de fallo de la Unidad central por la autoprueba.	R 29 "defecto menor" conmutación a realimentación apertura	- initialización - arranque Unidad
CAPT.POT-CIA	Defecto captador 4-20 mA de potencia eléctrica	R 129 "defecto menor" conmutación a realimentación apertura	- cancelación 2 nd F1

(1) Según el tipo de defecto

DENOMINATION	NATURALEZA	ACCION	PREPOSICION A FUNCIONAMIENTO NORMAL (Tras eliminarse el defecto)
CAPT. AGUAS ARR.	Defecto captador 4-20 mA de nivel aguas arriba	R129 "defecto menor" conmutación a nivel nominal	- cancelación 2 nd F1
CAPT; AGUAS ABA.	Defecto captador 4-20 mA de nivel aguas abajo	R129 "Defector menor" conmutación a nivel nominal	- cancelación 2 nd F1
CAPT PRES. DIF.	Defecto captador 4-20 mA de presión diferencial en el rodete	R129 "defecto menor" conmutación a salto nominal	- cancelación 2 nd F1
DEF PERRO DE .G.	Dis funcionamiento del perro de guardia	R29	-Inicialización
ORDRE EXT C/F	Defecto siñales procedente del orden EXT de carga	R129	- Cancelación 2 nd F1
DEFEC ECR. E2P	Defecto de escritura dentro E2PROM	R29	- Inicialización

6.4. Cancelación de los defectos

Las señalizaciones de defectos detectados por el equipo fisico desaparecen inmediatamente de eliminarse el defecto.

Respecto a los defectos detectados por el logicial, se precisa una operación de cancelación, la que se describe a continuación.

6.4.1 Defectos menores

Estos son defectos que provocan la activación de R129 y la iluminación de la luz "defecto menor".

Después de eliminarse la causa del defecto, oprimir sucesivamente las teclas 2nd F1. Desaparece la señalización del defecto y se apaga la luz "defecto menor" En este caso, hay tres posibilitades :

- Reaparece el parámetro anteriormente indicado : el DIGIPID queda nuevamente en servicio normal.

- Reaparece la señalización de defecto y vuelve a encenderse la luz "defecto menor" : no se ha eliminado la causa del defecto.
  Seguir buscando la averia.

- Aparece una nueva señalización de defecto y vuelve a encenderse la luz "defecto menor" : existia otro defecto. Buscar su causa y eliminarlo antes de proceder a una nueva cancelación.